MACHINERY

DESIGN — CONSTRUCTION — OPERATION

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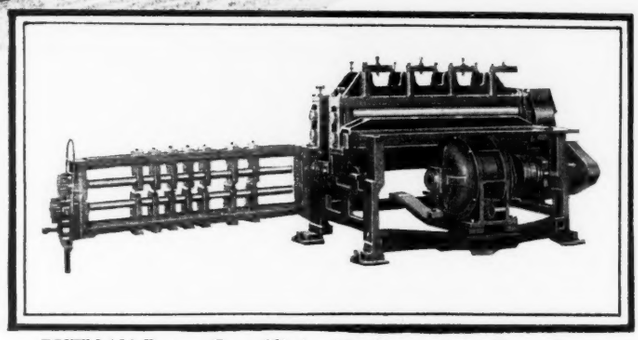

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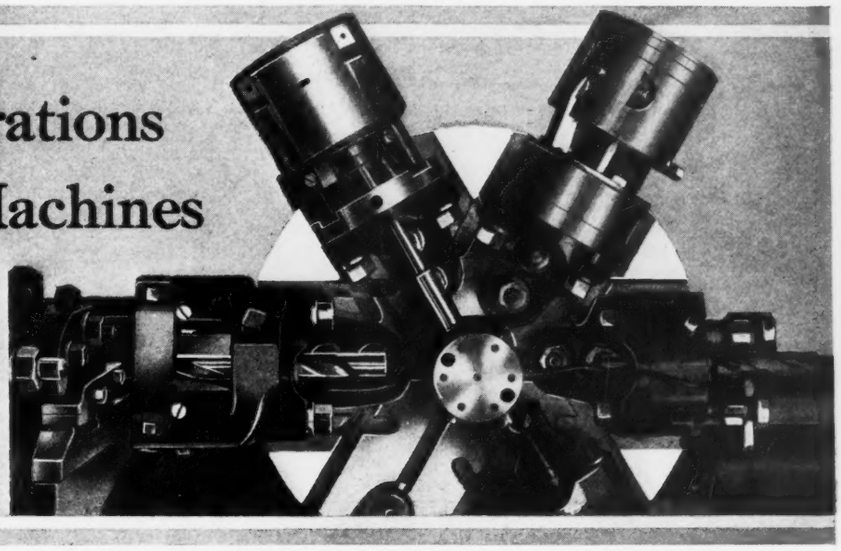
MACHINERY

Volume 35 NEW YORK, SEPTEMBER, 1928 Number 1

Press Operations on Screw Machines

Tools Used in Turret of Screw Machine for Performing Piercing, Slotting, Stamping and Similar Operations



By HENRY SIMON

PUNCHING or stamping operations requiring up to several thousand pounds pressure may at first seem incompatible with the character of an automatic screw machine. There is, however, nothing illogical in doing such work on this type of machine. The turret of such machines is capable of exerting a force at least equal to the end thrust on the largest drill used, and over an appreciable length of travel. If the stroke required for punching is short, then it is clear that this force can be multiplied a number of times, provided some form of tool is found which is compact enough for the restricted space available, and strong enough to stand up under the relatively heavy stresses necessarily set up within it.

The writer first considered the idea of applying the press principle to the screw machine when it became necessary to produce the group of parts shown in Figs. 1 and 2. Two tools, one for stamping four figures, and the other for punching a hole, were subsequently designed and built for the production of part *A*. The results obtained with these tools proved so encouraging that the idea was extended to the remainder of the group and later on to other parts. Several successive tools were designed, the final type being adapted to a wide range of work and to operations including stamping, slotting, perforating, flute forming, indenting, and others. The results obtained proved that punching and stamping on the screw machine, for work having the proper characteristics, is in many cases superior to any other method. In the following, the design and operation of the tools which have been developed for this work are described. Their possibilities and limitations, as indicated by four years' experience, is also dealt with.

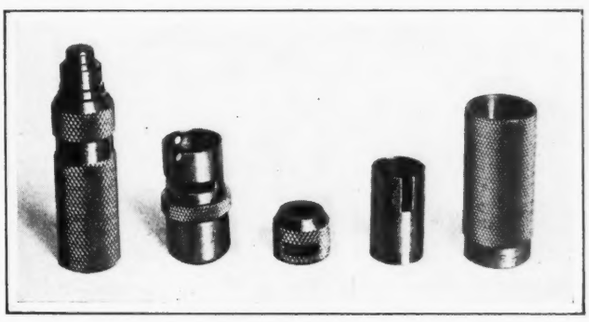


Fig. 1. Examples of Work Produced on Screw Machine Equipped with Press Tools

Set-up for Part Requiring Two Press Operations

The set-up for producing the steel part *A* is shown in the heading illustration. In order to appreciate the exigencies of this job, it is necessary to observe that the four figures 1, 1, 2 and 3 are required to stand out bold and clean on the highly finished surface of the collar, while at the same time the reamed 11/16-inch hole through the part has to be held to limits of $\pm$ 0.0005 inch at the numbered end.

These combined requirements would have rendered stamping or rolling as a second operation practically out of the question, so that engraving would have been left as the only good way to produce the figures. As against these complications, it is interesting to note the comparative simplicity of the set-up which produced the barrel complete, not only with the four figures deeply stamped and cleaned up, and a true bore through the part, but also with the 1/8-inch hole to the desired limits of $\pm$ 0.0005 inch, and in line with the figure 3. In the accompanying table is given the order in which the various machining operations on this part are performed.

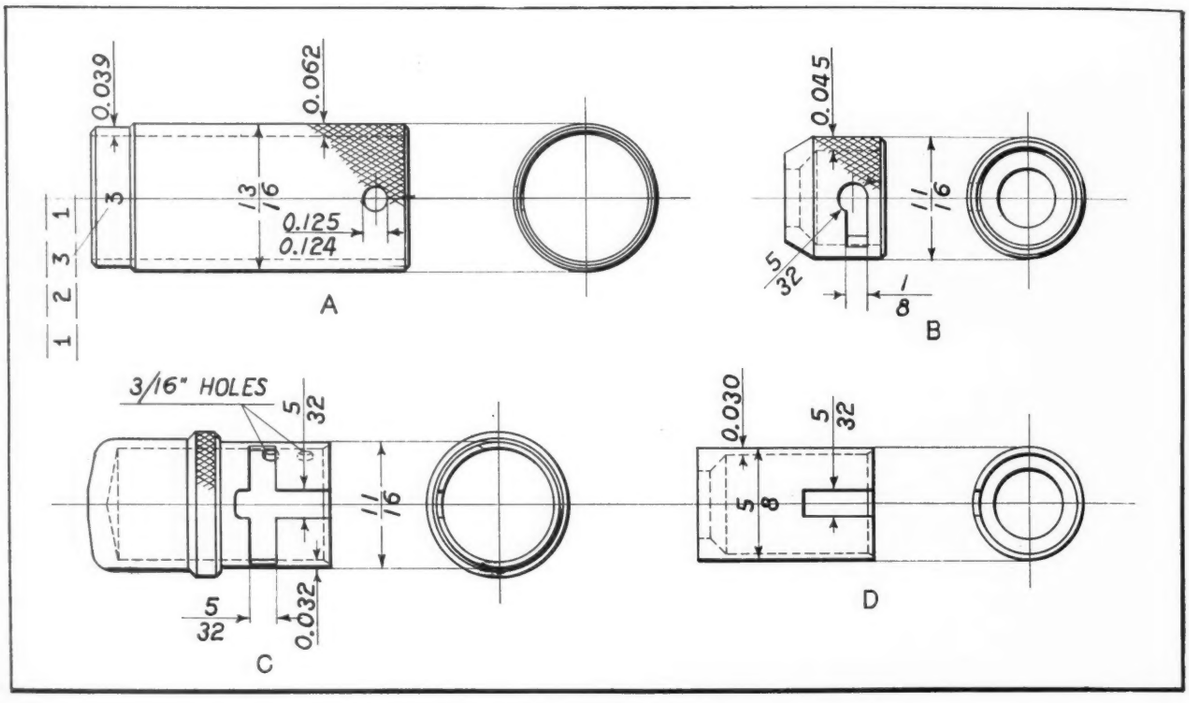


Fig. 2. Detailed Drawings of Parts Shown in Fig. 1

The time required for the two press operations is 14 seconds and the total time for the piece is 110 seconds.

Construction and Performance of Stamping Tool

All of the several designs of press tools which will be described are based on the same general principle. Each comprises a body adapted to be held in the turret, carrying a longitudinally movable block accommodating one or more transverse slides for receiving punches, and, usually, a die. As the turret advances, this movable member or "punch slide cage" strikes the chuck cap of the machine and telescopes, the resulting longitudinal relative movement being, by means of cams, translated into a shorter transverse power stroke of the slides.

The tool which stamps the figures on part *A*, Fig. 2, is shown in Fig. 3. The disk-shaped base *A* of this tool is secured to the turret. The cam tube *B* and the guide pins *C* project from the face of base *A*. The straight front portion of the cam tube provides the main support for the punch slide cage *D*, the pins *C* insuring circumferential alignment and acting upon the two springs *E*.

The rear portion of the hardened tube *B* is formed with a double-conical surface for actuating the four levers *F*, contact being through a ball-tipped adjusting screw *G* in the tail of each lever. The head of each lever engages a slot in the slide *H*, in which a stamp *I* is seated with a driving fit. A split piano-wire ring *J*, under tension from two small-diameter coil springs *K*, keeps the ends of the four levers at all times in contact with the cam.

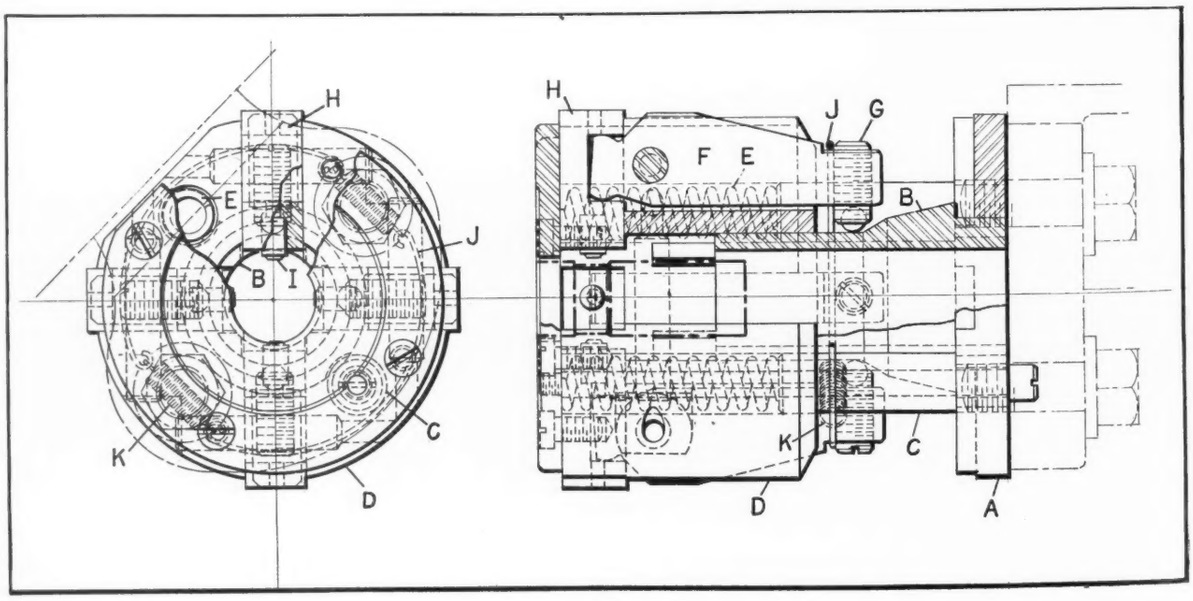


Fig. 3. Tool Used on Turret of Screw Machine for Stamping Figures on Part A, Fig. 2

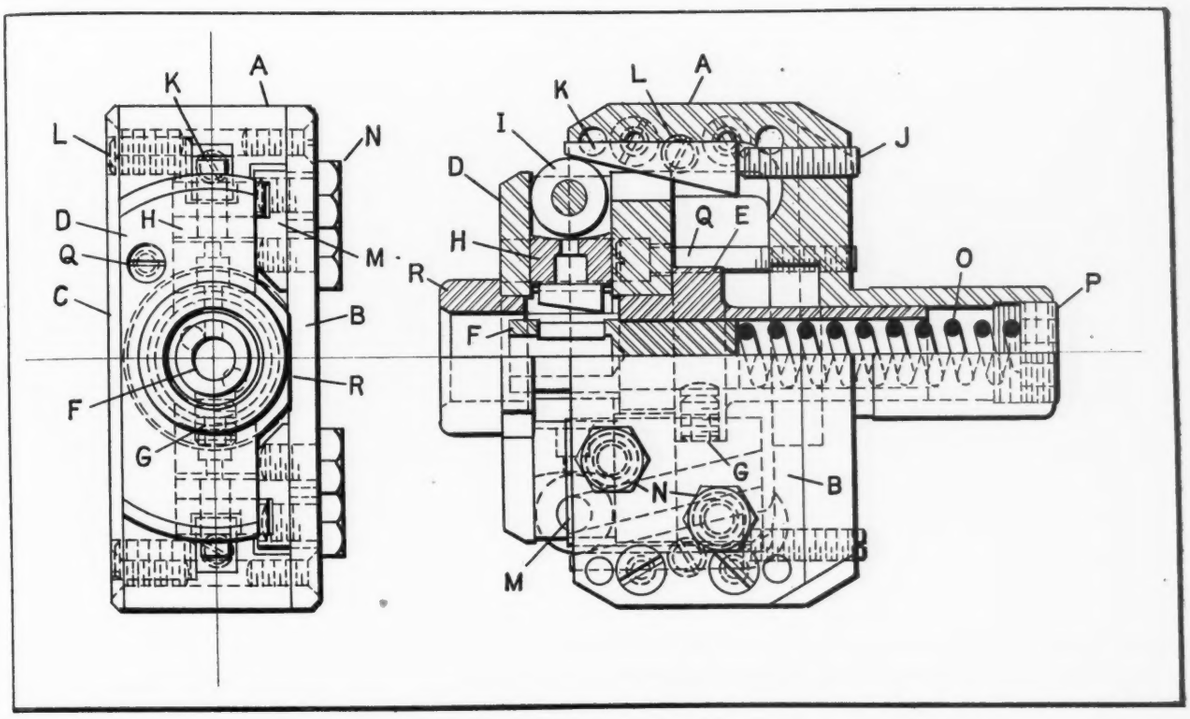


Fig. 4. Slotting Tool Used in Production of Parts Such as Shown at D, Fig. 2

With this, as with most of the remaining tools, the spindle is stopped during the operation. Since in this instance, the tool operates on a portion of the product which is still solid, no internal support is required. As cleaning of the hole is desirable for subsequent operations, an oil-tube is provided, as shown in the heading illustration in which the stamping tool appears in the upper left-hand position. As the turret advances, the four stamps are quickly brought in contact with the surface of the product by the action of the short camming incline. The complete stamping operation requires 8 seconds.

Tests made with the same figures under a screw press showed that an average pressure of slightly over 2000 pounds was required to stamp each of the four figures to the specified depth, so that a peak load of over 8000 pounds was developed in the tool. No failure of the tool to act or to withdraw from the work ever occurred. In the first 50,000 parts made, the only replacement was the stamp for the figure 3, which was slightly damaged. The expense for this replacement was only $2.

Practically the only trouble ever experienced was the breakage of the shearing pin in the turret, which occurred several times during the first few weeks of operation. This was due to excessively deep stamping resulting from the large tolerance of about 0.005 inch originally allowed on the collar diameter. As the pressure of stamping increases nearly as the cube of the depth, however, it was found necessary to hold the diameter within limits

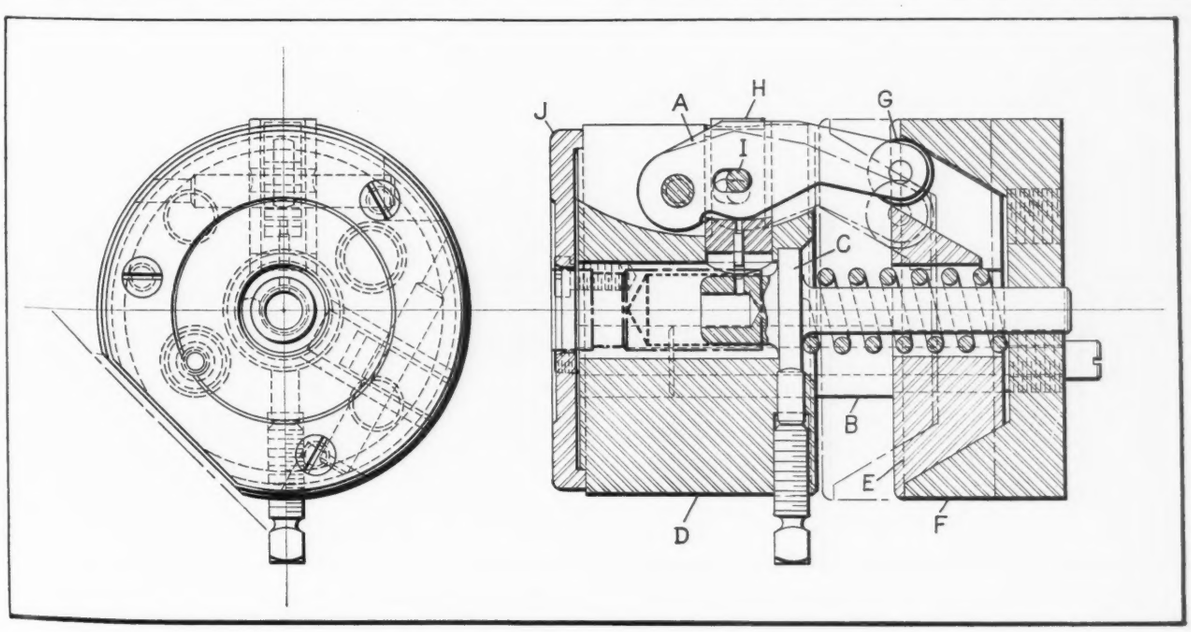


Fig. 5. Piercing Tool Employed to Pierce Hole in Part A, Fig. 2

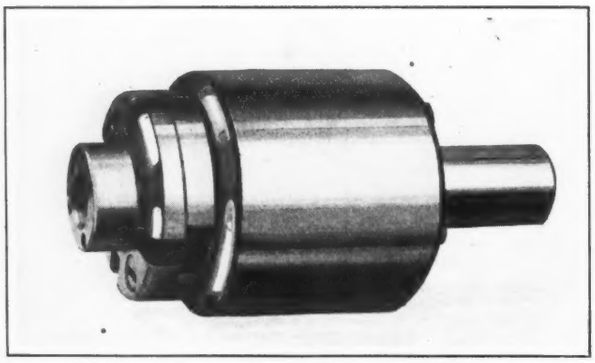


Fig. 6. Improved Type of Tool Which can be Fitted with Punches and Dies to Suit a Variety of Parts

of $\pm$ 0.001 inch. This eliminated breakage of the shearing pin.

Construction and Performance of Perforating Tool

The perforating tool, Fig. 5, largely followed the lines of the tool just described, except that it required a die and a more positive means for withdrawing the punch from the metal. Also, as this tool had to work on the outer end of a long product, a lever *A* of the second class was found more suitable. As this tool had to depend wholly on the guide pins *B* for the support of the punch slide cage *D*, the die *C* was made with a tail or stem which aided in maintaining alignment.

A double cam surface is obtained by the use of the concentric conical elements *E* and *F*, with which the lever makes contact through its roller *G*. Pressure on the work stroke is taken by the bottom of the slot in the punch slide *H*, pin *I* serving only for withdrawal. As this tool was intended to be used also on part *C*, Fig. 2, provision was made for a second lever and slide, variation of the distance of the punch from the chuck being obtained by means of a pad under the face cap *J*, Fig. 5.

The piercing punch, Fig. 5, also performed in a thoroughly satisfactory manner. Breakage of the punch at first occurred once every few thousand pieces, partly because of play in the tool which caused the punch to strike the end of the product, and sometimes because of chips which wedged between the die and the product and caused the tool to close prematurely. As the punch was quickly replaced and its cost was slight, the trouble was not serious in this case, and was reduced as soon as some of the lost motion had been taken up.

On this, as well as on other jobs in steel, trouble in the shape of premature closing due to chips was subsequently forestalled with improved practice, especially by the provision of a much greater clearance between the die and product than had at first been considered proper, and by forming the front of the die with a sharp square edge. About 4 seconds was allowed for the piercing tool to do its work, which, however, did not exceed a total load on the punch of 2000 pounds.

Design and Performance of Third Tool

The tool shown in Fig. 4 was next built, its first job being the forming of the slot in the part *D*, Fig. 2, on a No. 2 screw machine. On the basis of the experience gained with the tool shown in Fig. 5, the main points kept in view in the design of the new tool were: First, to give a rigid support to the punch slide cage; second, to provide a spring that is of ample length and strength; and third, to render the die cheap to make and easy to replace. The lever-and-cam construction was abandoned as requiring too much space and introducing complications into the design, and was replaced by cams acting directly on the punch slides.

In this tool, the body is made in the form of a stout rectangular shell composed of the main frame *A*, Fig. 4, and side plates *B* and *C*, held in place on the frame by dowels and screws. The punch slide cage *D* slides within this opening, alignment being insured by the engagement of the stem of the die-holder *E* in the hollow shank of the body. The die *F* is held in place by a clamp screw *G* acting upon a plug, and thus is rendered capable of quick adjustment.

Two punch slides *H* are accommodated in a diametral slot formed in one side of the punch slide cage. The slides are given their power stroke by contact of their rollers *I* with wedge-shaped cams *K* seated in the body frame, which can be adjusted by screws *J* and clamped by screws *L*. The return of the punch slides is brought about by the engagement of the protruding end of the roller pin with inclined slots in withdrawal cams made in the form of two floating plates *M*, which seal the space between the slotted face of the punch slide cage and the frame plate *B*.

These floating plates can be adjusted to bring their slots parallel to the incline of any primary cam used, and clamped by screws *N* so as to leave

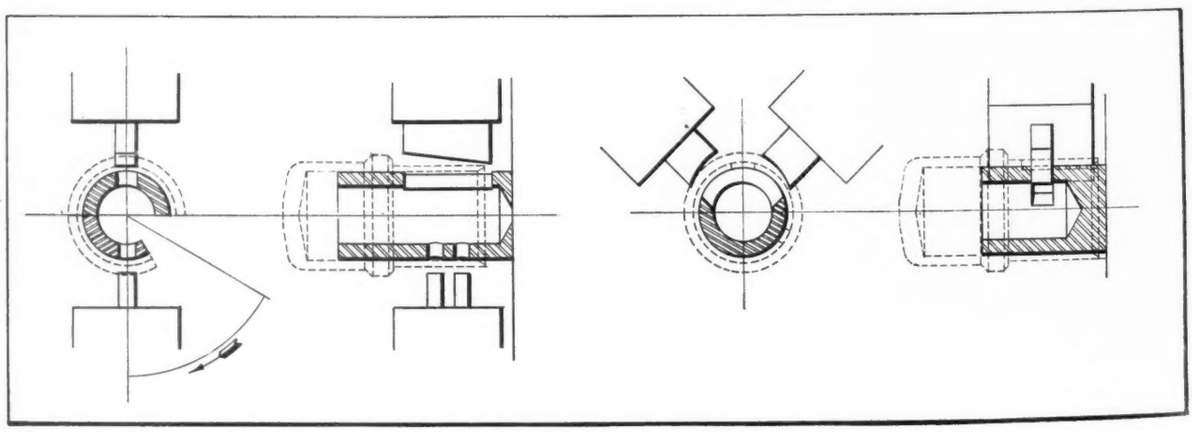


Fig. 7. Lay-outs for Slotting or Piercing Tools

practically no lost motion. The tension of spring *O* can be varied by means of a screw plug *P*, and its action is arrested by a check screw *Q*. The stock bushing *R*, frictionally seated in the front of the punch slide cage, controls the distance of the slides from the machine chuck and supports the front of the tool on the bar.

Excellent results throughout were obtained with this tool in making part *D*, Fig. 2. It was found that the initial time allowance of nearly three seconds could be reduced to nearly one second. The punch was given shear as shown, this reducing the maximum pressure to about 800 pounds. The punching was performed as the last turret operation just before the cut-off. Excepting some slight difficulties at the very start, which arose mainly through unfamiliarity with the clearance requirements of the die, the tool performed with a regularity and freedom from trouble which was truly remarkable.

Stops because of anything either directly or indirectly connected with the punching operation were very rare. Wear on the cutting edges of the punch and die was wholly negligible, and the action of the tool was remarkably smooth. Equipped for the job illustrated, the tool was considered by the operators who ran it as the one tool used which required no attention.

Operations on a Complicated Part

The next job was one of considerable severity. Production of the steel part *C*, Fig. 2, complete as shown, was contemplated. Two press tools were used in succession, the operations being timed just before the cut-off. The longitudinal slot and the two small holes were punched first with the tool shown in Fig. 5. The cross slots were formed by another tool of a type to be described later on. Reference will here be made only to the manner of tooling and the experiences with the punch and die.

The punches of both tools were given shear as shown in the lay-outs, Fig. 7, although owing to the limitations of the work stroke, as much shear could not be given as would have been ideal. Though the part was still within the capacity of a No. 2 machine, it was first scheduled for a No. 4, partly because of the existence of the tool shown in Fig. 5, which could be utilized by providing an extra punch slide. The experience gained demonstrated, however, that while the larger machine handled the tool right along without any difficulty, the operation of cross-slotting would have been beyond the capacity of the No. 2 machine because of the high turret pressure required. It may be added that the same job in brass could be easily negotiated by a No. 2 machine, since it would have required only about two-thirds of the pressure.

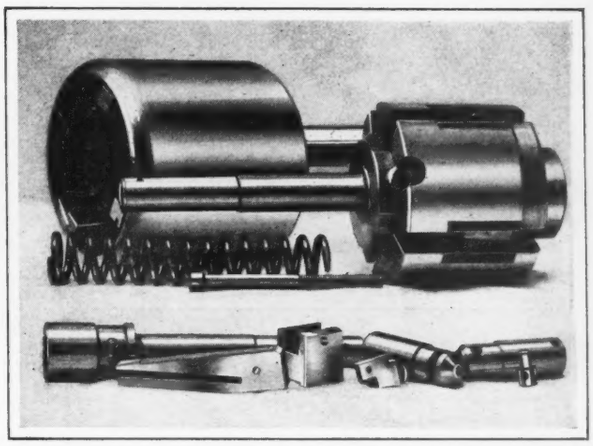


Fig. 8. Disassembled Parts of Tool Shown in Figs. 6 and 9

Troubles Met With

The actual experience with the part as made, showed that while the first tool could be brought to where it performed its work smoothly, the succeeding operation of cross-slotting was never wholly satisfactory. This was not due to the tool itself, but rather to the unavoidable peculiarities of the die. The opening in the die occupied over one-third of the circumference, while the hole through it could not be reduced below a certain safe minimum without experiencing trouble in the discharge of the punchings. Even so, packing of chips occurred a number of times and in two or three instances caused breakage of a die. The average

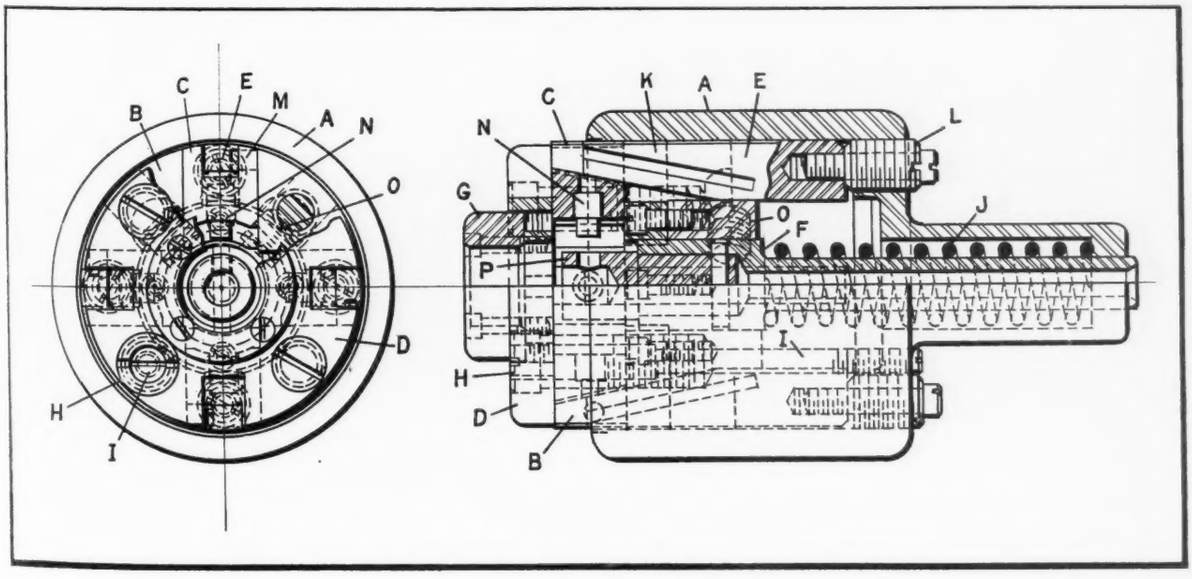


Fig. 9. Assembly of Tool Shown in Fig. 6

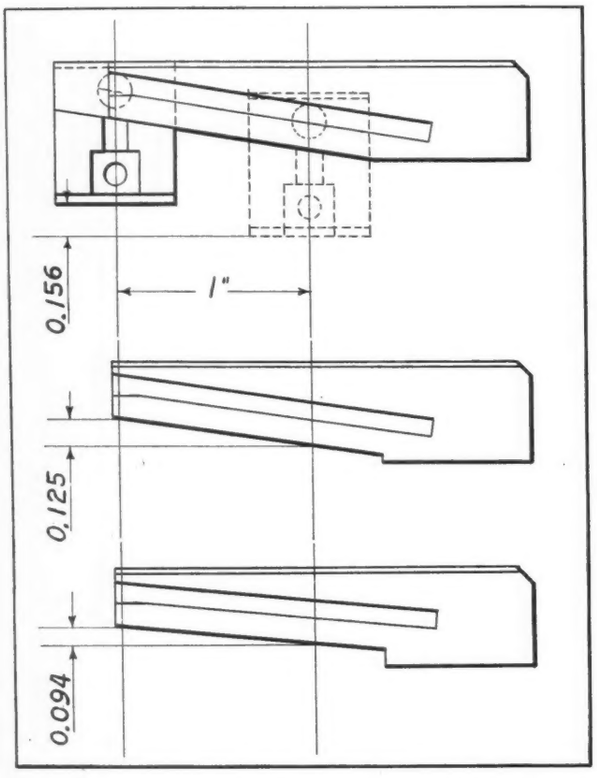


Fig. 10. Interchangeable Cams and Punch Slides with Different Inclines for Use in Tool Shown in Fig. 9

life of a die was not over 5000 pieces, which at a total expense of about $8 for replacement added too much to the cost of the parts.

With the tool shown in Fig. 5, which was used on the first operation, one or two die breakages occurred at the beginning. These were due to the unnecessarily thin wall and too high a temper of the die, and were subsequently avoided by increasing the wall thickness to about 1/8 inch and drawing the die to nearly a blue, with the punch left the usual temper. Troubles in the shape of the packing of punchings did not occur, and trouble from premature closing was never serious and was reduced to the point of unimportance when the clearance between the die and the product had been increased to 0.015 inch and the face end formed with a sharp square edge.

It should be mentioned, in regard to the punching operations so far described, that with the possible exception of the cross-slotting, practically no trouble would have been encountered if the pieces of work, though requiring the same pressures, had all been brass. The difficulties met with resolved themselves largely into those caused by coarse steel drill chips, and were mainly in the shape of premature closing of the tool. The experience gained with part *D*, Fig. 2, and later with other parts showed that with a good clearance between the die and the product and with a spring of fair power, brass turnings were unlikely to cause premature closing of the tool.

The tool shown in Fig. 6 was developed on the basis of the experience gained with the four preceding types. It combines most of their good points with greatly increased versatility and range. The construction is inherently strong, and all working parts are fully protected against injury from outside causes as well as from the results of excessive strains. Particular attention has been given to so shaping the design as to have all parts easily accessible and readily adjusted. The tool shown is for a No. 2 machine, and duplicates were built simultaneously. An idea of its capacity may be had from the following specifications:

Largest diameter.....2 7/8 inches
Greatest length of body without stock bushing.....3 7/16 inches
Largest diameter of stock that can be handled..... 3/4 inch
Total capacity of tool (pressure on punches) using all four punches, with load evenly distributed:
When used on No. 2 machine....3500 pounds
When used on larger machine...5000 pounds
Maximum capacity with two punches:
When used on No. 2 machine....2500 pounds
When used on larger machine...3750 pounds
Maximum capacity with one punch..2000 pounds
Greatest diameter of round hole that can be made..... 3/8 inch
Greatest thickness of metal that can be perforated when punching 3/8-inch hole in brass..... 0.038 inch
and in steel..... 0.023 inch
Greatest thickness of metal that can be perforated when the hole diameter equals the thickness of the metal (for brass)..... 0.095 inch
(for steel)..... 0.080 inch
Greatest distance from chuck to center of punch.....1 11/16 inches
Least distance from chuck to center of punch..... 11/16 inch
Greatest distance product can project from chuck and be perforated.....2 5/16 inches

Construction of Tool

All parts of this tool are hardened, the body *A*, Fig. 9, being of machine steel, while all remaining parts except screws are made from tool steel. The cage *B* receives the punch slides *C* in radial slots formed across the face, which are closed by the face cap *D*. The punch slides are actuated by bar-shaped cams *E* accommodated in connecting lengthwise slots in the cage and resting upon the inner surface of the body shell. In the rear end of the central hole through the punch slide cage is located the die-holder *F*, the stem of which aids in maintaining alignment by its bearing in the end of the body shank.

Machining Operations on Part A, Fig. 2

Front Cross-slide	Rear Cross-slide	Turret
Form	.....	1. Feed stock to stop 2. Knurl and drill 51/64-inch hole 1 3/8 inches deep 3. Stamp figures 4. Punch 1/8-inch hole
	Clean up collar	5. Finish drilling 51/64-inch hole 6. Ream hole to 13/16 inch Cut off with swing tool on 1.

Machinery

Considering some of the details, it will be seen that the face cap has a shallow recess for the stock bushing *G*, to which reference will be made later. Of the four screws holding the face cap to the cage block, *H* is hollow to receive the head of the check screw *I*, which controls the extension of the punch slide cage under pressure of the spring *J*. The location of any or all punch slides is made variable lengthwise of the cage by means of spacers *K*, which may be attached either to the front or rear wall of the punch slide seat. The cams are a close running fit in the slots in the cage and are thus supported in every way except longitudinally, where they are adjustably held by double screws *L*.

Each cam is made with a primary incline on the face for the work stroke, and a secondary parallel incline in the form of a slot, for the return of the slide. Each punch slide is made with an incline identical with that of the cam used in connection with it, and is withdrawn on the return stroke by the engagement of the short pin *M* in the slot in the cam. A 1/4-inch hole in the bottom of each slide forms a standard seat for the stem of the punch, which is locked in place by a cross-pin *N*.

The die-holder is a snug push fit in its seat in the punch slide cage, which renders it easy of adjustment with reference to the punch, and is locked in place by two set-screws *O* acting upon copper pads. The die *P*, in the shape of a short cylindrical plug, is firmly cross-pinned in the die-holder. A hole throughout the entire length of the die-holder provides for a knockout, and if continued through the die, establishes a passage for oil under pressure from the turret. In Fig. 8 is shown the tool with the punch slide cage removed, the lower view showing a duplicate die-holder, punch slides and dies.

Different Cam Inclines Provided

Three different cam inclines are ordinarily used, calling, of course, for matching cams and punch slides. These are shown in Fig. 10, the inclines ranging from a maximum of 0.156 inch to a minimum of 0.094 inch for the full one-inch movement of the punch slide cage, or "run" of the tool. This gives a leverage ratio of from 6.4 to 1 to 10.6 to 1. It should be noted that any combination of these inclines can be used simultaneously in the same tool.

Outside of punches and dies, the stock bushing *G*, Fig. 9, is the only part which may require to be changed for different jobs. Except for work where one of two successive press operations has to be spaced exactly with reference to the other, however, a set of eight or ten bushings differing by sixteenths of an inch in hole diameter and by eighths of an inch in length, is enough to take care of all requirements.

A succeeding article will deal with the operation of the tools on work which revolves while the tool is in operation, as well as the problems met with in designing press tools for use on screw machines.

* * *

According to a world census of motor vehicles made by the Department of Commerce, there were at the beginning of this year 29,687,000 automobiles in use throughout the world. Nearly 90 per cent of these were of American manufacture.

THE MACHINE TOOL EXPOSITION IN 1929

The National Machine Tool Builders' Association has announced plans for its second machine tool exposition to be held in Cleveland beginning Monday, September 30, and closing Friday, October 4, 1929. The exposition will be held in the Cleveland Public Auditorium Buildings under the sponsorship of the association, and the same area as was used for the first exposition in 1927 will be used for exhibition purposes in 1929.

An exposition committee of the association is in charge of the arrangements, consisting of J. Wallace Carrel, Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, chairman; Henry Buker, Brown & Sharpe Mfg. Co., Providence, R. I.; Ralph E. Flanders, Jones & Lamson Machine Co., Springfield, Vt.; Robert M. Gaylord, Ingersoll Milling Machine Co., Rockford, Ill.; and James E. Gleason, Gleason Works, Rochester, N. Y. P. E. Bliss of the Warner & Swasey Co., Cleveland, Ohio, president of the association and Ernest F. DuBrul, the association's general manager, are also active in the committee's work.

It has already been announced by the committee that the definite order of preference for the admission of exhibits to the exposition has been established as follows: (1) Machine tool exhibits by members of the National Machine Tool Builders' Association. (2) Machine tool exhibits by American builders not members of the association. (3) The trade press; direct accessories used exclusively on machine tools, such as chucks, small tools, etc. (4) Accessories and supplies not used exclusively in connection with machine tools, such as antifriction bearings, driving devices, and shop supplies.

The 1929 exposition will again restrict the attendance to those interested commercially, technically, or educationally in machine tools or in the equipment, supplies, accessories, and materials related to their production and utilization. Last year the total exposition registration, based upon the same principle of admitting only qualified visitors and excluding the general public, exceeded 11,000 persons, and represented many countries outside of the United States and Canada, the exposition taking a definite place among the world's outstanding industrial displays.

Last year, 130 companies displayed and demonstrated their products, and 2300 men were employed in connection with the exhibition to operate the machinery and equipment and to represent the exhibitors. Such a large part of the equipment was in actual operation that about 4000 horsepower was required for driving the machinery.

Allotments of display area will be handled through the executive offices of the National Machine Tool Builders' Association, 630 Vine St., Cincinnati, Ohio. The details of the exposition management will be taken care of by Roberts Everett, 225 W. 34th St., New York City, who acted in the same capacity for the previous exposition.

* * *

At the present time there are in the United States over 600,000 miles of routes covered by bus lines, as against about 300,000 miles of steam and electric railroad lines.

Machining Nash Valve Tappets

By CHARLES O. HERB

IN most automobile plants, highly efficient methods are employed not only in manufacturing such important parts as the cylinder block, pistons, crankshaft, camshaft and various gears, but also in producing minor details. This article will describe several high-production operations as performed at the Racine, Wis., plant of the Nash Motors Co. in making valve tappets for the Nash "Light Six" automobile. These tappets are iron castings of the construction shown in Fig. 2. Surface *a*, which rests constantly on a cam of the camshaft, is chilled in the mold so as to increase its resistance to wear. The tappet is finished all over, surface *a* and shank *b* being ground.

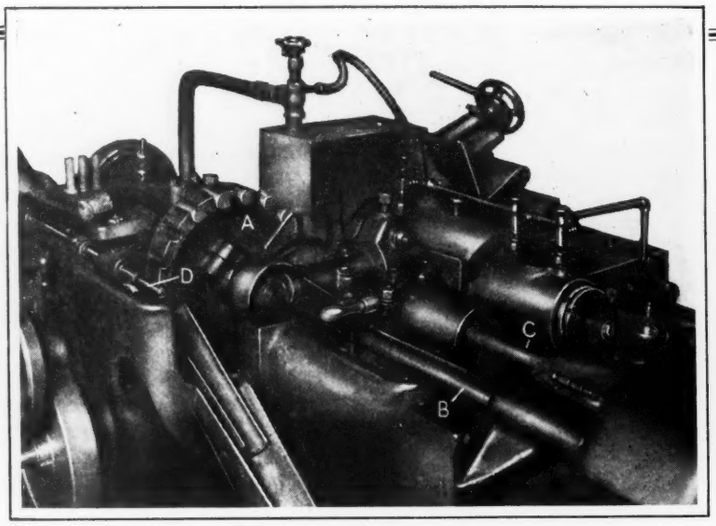


Fig. 1. Rough-grinding the Shank or Stem of Valve Tappets in a Machine Equipped with an Automatic Indexing Work Carrier

Preliminary Operations Consist of Grinding

The first operation on the tappets is centering the shank end in a drilling machine. They are then brought to the Arter grinding machine illustrated in Fig. 1, for rough-grinding surface *b*, Fig. 2. In this operation the work of the operator consists merely of loading the indexing drum *A*, which is driven through shaft *B*. As each tappet is brought into the grinding position by the drum, a center mounted in a head on the left-hand side of the machine advances into the center hole previously drilled in the shank end of the tappet. Simultaneously, a collet chuck driven through shaft *C* advances over the head of the tappet, gripping it securely for rotating the tappet against the grinding wheel a predetermined number of times.

When the grinding has been completed, the collet and center heads withdraw, while drum *A* indexes to bring the next tappet into the grinding position. As each ground piece reaches the front of the machine a plunger *D* moves horizontally toward the right to eject the piece from the drum. This plunger is illustrated in the extreme forward position. About 200 parts are ground per hour on this machine, from 0.030 to 0.040 inch of stock being removed on the diameter of the tappet.

The tappets are next passed to a small cylindrical grinding machine where periphery *c*, Fig. 2, of the head is ground, while the shank end is driven by a spring collet chuck in which it is accurately held in relation to the wheel. Face *a* is next ground in a second cylindrical grinding machine of small size. Again the shank is held in a collet chuck, but at right angles to the axis of the grinding wheel, and the part is rotated as the wheel is reciprocated back and forth across face *a*. The operator controls the movement of the grinding wheel with his right hand, and opens and closes the collet chuck with his left.

Next the tappets reach a Cincinnati centerless grinding machine in which a second roughing cut is taken on shank surface *b*. After a lot of parts have been run through this machine, the grinding wheel is adjusted and the same pieces are run through a second time for semi-finish grinding the shank. Then the tappets are passed to another machine of the same type, in which the shank is finish-ground. Four grinding operations are thus performed on surface *b* and it is finished within a diameter tolerance of 0.0005 inch. In each of the centerless grinding operations referred to an average production of 250 tappets per hour is obtained.

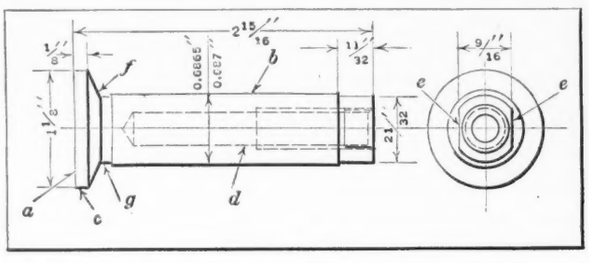


Fig. 2. Construction of Valve Tappet Used on Nash "Light Six" Automobile

Drilling the Shank End in an Automatic

Hole *d*, Fig. 2, is drilled in the tappets by four separate tools of the Acme five-spindle automatic illustrated in Fig. 3. For this operation, an auxiliary split collet is slipped over the shank of each tappet, as shown at *A*, and the collets of the machine itself are bored to suit the diameter of these auxiliary collets, which is somewhat greater than the diameter of the tappet heads. With this arrangement, the tappets can be gripped firmly on the shank after they are slipped into the machine collets.

Each tappet with its auxiliary collet in place is laid on the inclined block *B*. With each withdrawal of rod *C*, when the end tool-slide of the machine moves toward the left to permit indexing of the spindle carrier, one of the tappets rolls into the loading position. Then, as rod *C* moves forward with the return of the end tool-slide, it pushes the work with the auxiliary collet into the collet of the machine spindle that happens to be in line.

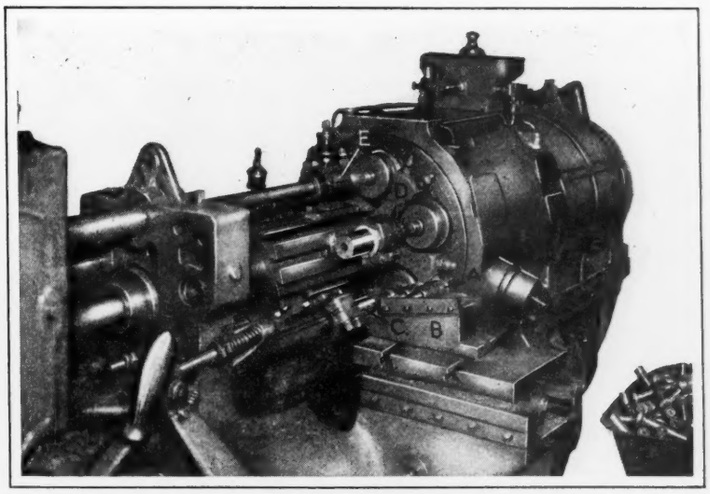


Fig. 3. Drilling, Turning and Facing the Tappets in a Five-spindle Automatic

When the tappet is indexed into the next position, a starting drill mounted in holder *D* on the end tool-slide, cuts a generous center into the shank end of the tappet as this tool-slide advances. After the second indexing, a 21/64-inch drill held in the spindle of head *E*, advances and drills hole *d*, Fig. 2, for one-half its length, or 1 3/16 inches. A "slow flute" drill of the same diameter completes the drilling of this hole to a depth of 2 3/8 inches, after the third indexing of the tappet. When the fourth working position is reached, a 23/64-inch drill is used to bore the hole to a depth of 1 1/4 inches, thus preparing the hole for a later tapping operation. During this final drilling step, a tool on the rear cross-slide of the machine faces the shank end to length and turns this end to the 21/32-inch diameter. The production of this automatic averages 400 tappets per hour.

A High Production Milling Operation

Flats *e*, Fig. 2, on opposite sides of the shank end are produced on a Milwaukee vertical-spindle milling machine equipped with a continuously revolving fixture *A*, as shown in Fig. 4. Four cutters on the spindle simultaneously mill both flats of two tappets as the fixture carries them past the cutters. The operator merely slips the tappets into holes in the side of the fixture. As the tappets reach the spring-actuated blocks *B*, these blocks force the tappets against the fixture wall. Immediately afterward the tappets are securely clamped for the operation as the corresponding dog *C* strikes the adjustable stop *D*. As this occurs, the dog swivels and actuates clamps on four tappets at the same time.

After each group of four tappets leaves the cutters, the corresponding dog *C* strikes a bar on the left-hand side of the machine, which causes the dog to swing into the open position, thus releasing the four tappets which it had clamped. The operator can then readily remove the finished pieces, place them on chute *E*, and reload the fixture with new parts. In this operation a production of 1200 pieces per hour is obtained.

Unique Arrangement Facilitates a Tapping Operation

The tapping of hole *d*, Fig. 2, to receive an adjusting screw, is performed with the Gaterman pneumatic oscillating machine illustrated in Fig. 6. A standard S.A.E. 3/8-inch tap with 24 threads per inch is used, and the hole is tapped to a depth of 1 1/8 inches. The machine is equipped with a simple work-holding fixture which expedites the operation, an average of 600 pieces being tapped per hour.

This fixture is provided with two work-holding stations. Either of these is quickly placed beneath the tapping spindle by operating a lever that cannot

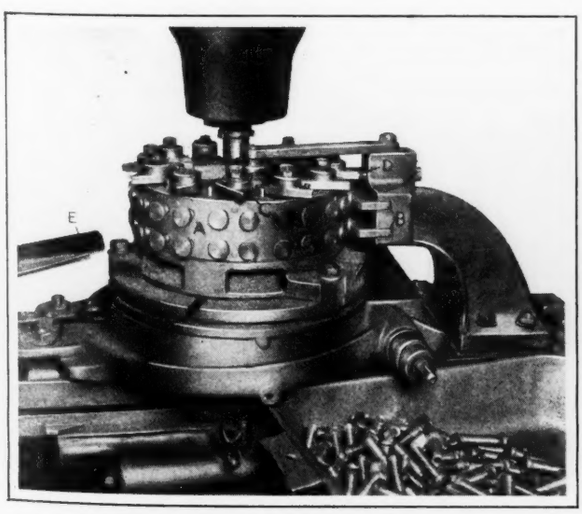


Fig. 4. Milling Flats on One End of Tappets at the Rate of 1200 per Hour

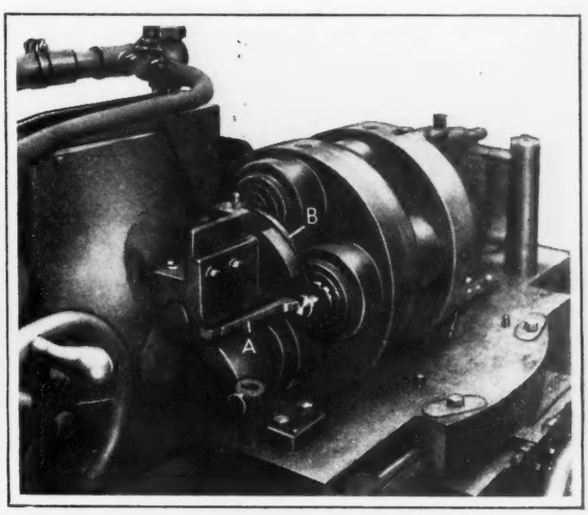


Fig. 5. Finish-grinding Operation on the Chilled Face of the Tappet Heads

be seen in the illustration. This lever actuates a pinion which is engaged with a rack fastened to the table on which the work-holding stations are mounted. While one piece is being tapped, another piece can be conveniently placed in the second station ready for moving into position beneath the spindle when the first piece is finished.

In loading a tappet in either work station, its head is seated on a hardened plug *A* which has a flat top. The shank is slipped under a flat spring *B* which holds the shank vertically against the vees of block *C*. When the tappet is moved into the tapping position, the flat end of a horizontal plug on the inner side of brace *D* firmly pushes the work against the vees of block *C* so as to locate it accurately for the operation.

After the tapping, angular back *f* of the tappet head, Fig. 2, and groove *g*, are ground in a machine equipped with a wheel trued to suit the shape of these surfaces. The axes of the work and of the wheel are parallel, and the wheel is fed toward the work for the operation. About 12 pieces are ground per minute.

Finish-grinding the Chilled Surface

The final operation on the valve tappets consists of finish-grinding face *a* of the head, and is performed in the Arter grinding machine shown in Fig. 5. Before the parts are placed in this machine, they are dipped in kerosene so as to thoroughly cleanse them of all dirt. This machine is also equipped with an indexing fixture which automatically carries each part to the wheel for grinding, the tappets revolving during the operation. About 0.003 inch of stock is removed from the chilled face and about 400 tappets go through the machine per hour.

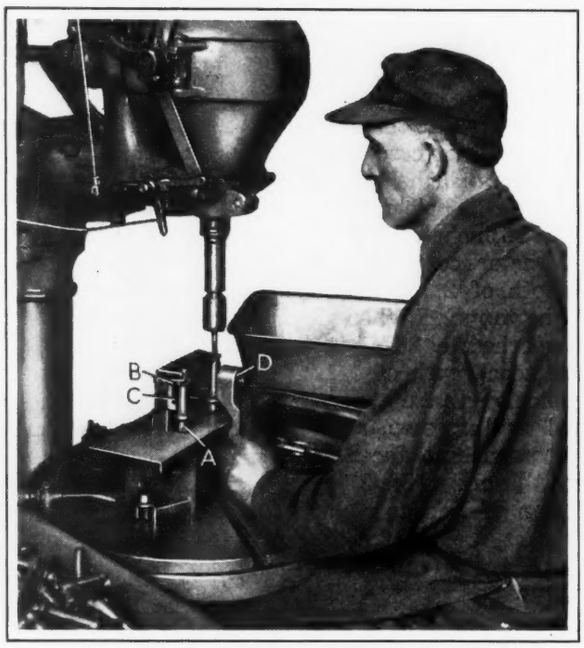


Fig. 6. Tapping Operation in which a Simple Quick-acting Work Fixture Expedites Production

The work carrier is ordinarily enclosed with a guard; only the collet that happens to be in the loading position at any time is exposed to the operator. When a tappet is being slipped into any collet of the work spindle carrier, the spring latch *A* is pushed into its bracket, but as soon as the tappet is in place, this latch springs forward, as shown, to hold the tappet in the collet. As the tappet is indexed from the loading position, its face slides on guide plate *B* until it reaches a horizontal roller. This roller accurately positions the tappet while the collet of the work spindle closes on it, thus insuring the same relative position between all tappet faces and the grinding wheel.

When the tappet has been indexed to the third position, the slide on which the work spindle carrier is mounted, moves transversely to carry the work across the face of the grinding wheel. At the same time, the grinding wheel is fed toward the work. As the fourth work station is reached, the collet is automatically opened and the finished tappet ejected.

* * *

SAFETY AND PRODUCTION

The American Engineering Council has made an engineering and statistical study of the relationship between industrial safety and production. Twenty different industries and the manufacture of sixty different products have been studied in gathering the data that make up this report. It is pointed out very definitely that by taking proper safety measures it is possible to maintain safe working conditions without curtailing production. In fact, during the periods studied, it was found that the safety of operation increased at the same time that production increased.

One of the tabulations shows a study of nineteen different industrial groups with over 500,000 employes, covering a period of from three to ten years, where there had been a marked increase in production and decrease in accident frequency and severity. The commendable work of the United States Steel Corporation is especially emphasized. One example is cited of a department employing 300 men in which there were no accidents for over four years.

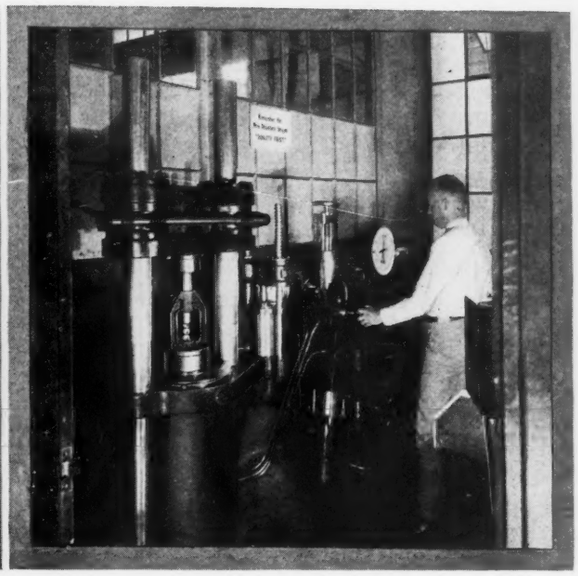
The form in which the report is presented calls for special comment, apart from the contents of the report itself. While the total report occupies a book of 414 pages, 6 by 9 inches (published by Harper & Bros., New York), the results of the investigation are summarized in the first thirty-seven pages, and those not concerned with details can obtain from these introductory pages a complete idea of the conclusions reached through the investigation.

* * *

According to information furnished by the Amtorg Trading Corporation, 165 Broadway, New York City, the Soviet-American trade for the first nine months of the Soviet fiscal year beginning October 1, 1927, reached a total of over $100,000,000. American-Russian trade in 1913 totaled $48,000,000 for the entire year. Orders placed for machinery and other factory equipment amounted to about $10,000,000 during the nine months referred to. Agricultural machinery and equipment was valued at $8,775,000. The exports to the Soviet Union amounted to over $83,000,000, while the imports amounted to about $17,000,000.

Ball Bearings for Main Spindles

The Application of Ball Bearings to Machine Tools of Different Types and Spindle Arrangements



By H. W. HOLDSWORTH, Engineering Department, New Departure Mfg. Co., Bristol, Conn.

IT has been stated that one of the outstanding features of the present advance in machine tool design is the pronounced increase in the use of ball and roller bearings. While it is true that there has been a general move toward wider adoption of these bearings, the greatest point of interest undoubtedly lies in the use of such bearings in positions formerly occupied almost exclusively by the sleeve type bearing. Although sleeve type or plain bearings unquestionably have their place, machine tool designers and bearing makers alike have long been aware of the fact that their limitations for certain specific purposes have definitely restricted the production capacity of many machines.

The advent of numerous highly successful applications of ball bearings to such positions has resulted in a strong demand for mountings of this type. Among the most interesting and advantageous of these applications are those which have been and are now being adopted for the main spindles of grinding machines, automatic chucking machines, production lathes, milling machines and similar manufacturing equipment. The increasing demand for greater speed, greater accuracy, greater endurance and lowered maintenance has already brought about such marked improvements as to amply justify any further changes that may be necessary to extend the use of these more efficient bearings.

In a general way, the application of ball bearings to main spindles requires mountings similar to those required for other less exacting positions, but there are certain essentials peculiar to the installation of main spindle bearings which must be observed and adhered to in order to obtain the greatest accuracy and endurance. Before referring to the typical installations to be described, it is well to consider briefly certain characteristics of the ball bearing which are of vital importance in its application to main spindles.

Deformation and Contact Area of Balls

When any ball or roller bearing is placed under load, a certain amount of deformation takes place in the rolling elements and their races. Under no circumstances where a load is applied to a ball is

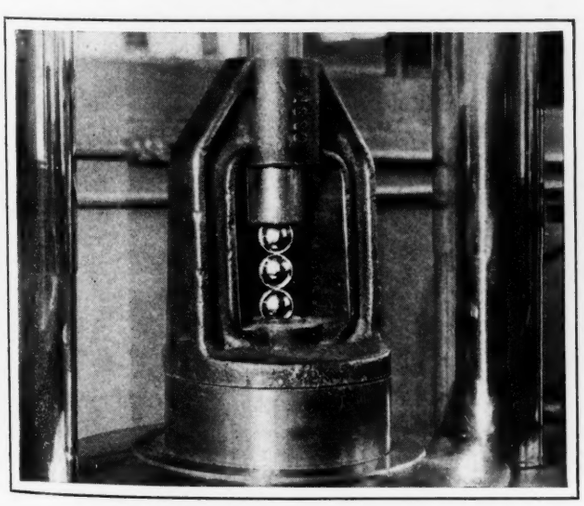


Fig. 1. Method of Testing the Crushing Strength of Steel Ball

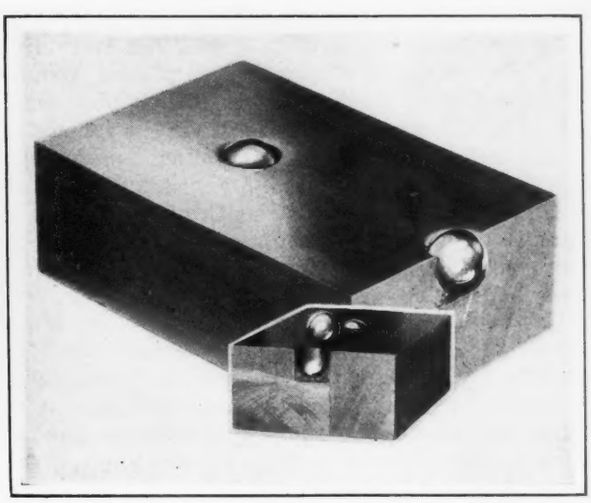


Fig. 2. Hardened Steel Bearing Balls Pressed Into Steel Block

the contact between it and the raceway other than a decided area. It is never a "point." It is important to bear this in mind because it is largely responsible for the load capacity of the bearing. The enormous strength of a steel ball is seldom fully appreciated, but may be graphically demonstrated by laboratory tests. When tested for crushing strength, three balls are placed in line, as shown in Fig. 1 and in the heading illustration, which includes the complete testing machine.

Enormous Crushing Strength of Balls

Since the top and bottom balls are supported on cupped surfaces when testing for crushing strength, as shown in Fig. 1, the area of contact between the balls and the cupped surface is greater than between the center ball and the balls above and below. For this reason, when sufficient pressure is applied, the center ball is crushed.

If a steel ball is placed upon a tough steel block and enough pressure applied through a hardened block having a very slight depression in its end, the ball may be forced entirely into or through the lower block without material injury to the ball. The results of a test of this kind are shown in Fig. 2. It is important to note here that the three-in-line crushing strength of the 17/32-inch balls shown in Fig. 2 is approximately 30,000 pounds, but it required a pressure of 108,000 pounds to force one ball into the steel block, yet the sphericity of the ball remained practically unchanged when it was cut from the block and gaged. The fact is thus established that the strength of the balls in a spindle bearing having deep raceways, quite closely conforming to the ball curvature, is many times that which will be required of them in service.

However, since accuracy is one of the chief essentials of a spindle mount, the ball bearings must be so applied that any possible deflection is well within the limits of the accuracy stipulated. When ball bearings of the proper size are selected for a spindle, they are capable of resisting a great deal more than the maximum working load which will be imposed. This means that they are also capable of a much greater amount of elastic deformation within easily safe limits than will be caused by the maximum load. They can, therefore, be set up under a predetermined initial load sufficient to establish a proportionally greater deformation than could be caused when the heaviest working load is applied. This is always done to insure the elimination of radial and axial movement. It is important to observe here that a ball bearing can be set up this way with practically no increase in rolling friction or decrease in over-all efficiency or endurance.

Necessity for Proper Static Load

In approaching spindle applications we have, therefore, the basic principle that the bearings must be mounted so that they are placed under a suitable initial static load, which must bear the proper relation to the maximum working load. The number of bearings used and the exact method of applying them is largely dependent upon the type of the machine. Thus if the main spindle is short and of ample diameter there is seldom anything to be gained by the use of more than two bearings, as in Fig. 3. In this application, which is for a large automatic, the spindle is of such proportions that deflection of any consequence does not occur and additional support between bearings is not required. Both bearings are press-fitted on the shaft as well as in the adapter sleeves in which they are housed. Care must be exercised to insure that proper fits are secured for the sleeves in the housing bores, since too loose a fit, particularly on the forward sleeve, might possibly permit deflection to occur when the load is increased. The front bearing sleeve is a light press or tap fit and the rear sleeve a very snug push fit, the latter being necessary since pre-loading of the bearings is obtained through a slight axial movement of this member. Enough load is placed upon the bearings by this means to eliminate chatter when taking the heaviest cut.

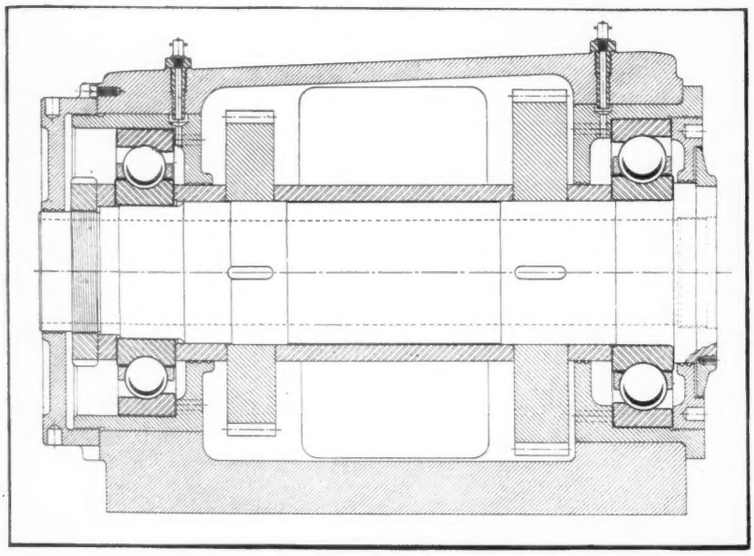


Fig. 3. Short Main Spindle of Large Diameter Equipped with Ball Bearings

In ordinary ball bearing applications, where the limits of accuracy are not so exacting, it is customary to mount the bearing outer races in the housing with a push fit. This is done to permit a slow creeping or rotation of the race so that the maximum load is continually being taken on a fresh portion of the raceway.

Where the bearings are placed under a definite initial thrust load, however, all of the balls take their proportionate share of the load, the raceways are more evenly loaded, and creeping of the outer ring is not necessary. For this reason, the bearings are given tighter fits in the housing, thus eliminating the possibility of radial play at this point.

Spindles Requiring Three Bearings

In a great many machine tools it is not possible to make the spindle of such proportions that some additional support against deflection of the spindle is not desirable. In such applications the use of three ball bearings, mounted as in Fig. 4, has been

found extremely successful. Here, the front bearing is pressed lightly directly into the housing frame, but the intermediate bearing is pressed into an adjustable sleeve. This sleeve is not only a very snug push fit in the housing, but is of such length that undesirable radial movement between it and the housing is prevented. Rotation of this sleeve and the consequent change in the initial load placed on the two forward bearings is not possible, since an extension of the lubricator fitting is brought down to act as a key in a slotted portion of the sleeve. Since the load on the intermediate bearing is the initial or pre-load obtained through the sleeve adjustment, a very rigid support against shaft deflection or whip is obtained at this point.

The mounting for the rear bearing is very similar except that the axial load is applied by means of a number of coil springs. In this way the load is maintained at a constant value irrespective of any change which might occur in the shaft length due to expansion. With sleeve bearings, precision to a comparatively close degree may be built into the main spindle by the exercise of much careful scraping and fitting. There are difficulties, however, in obtaining perfect operation. In order to obtain minimum deflection under load, fits must be close, that is, the clearance for the oil film is made very small. Under such conditions, overheating and attendant troubles are always possible.

Again, though satisfactory precision may be attained initially, this precision in many cases is of too temporary a nature, especially considering the general excellence of the tools in most other respects. It is a fact now receiving the attention of numerous machine tool builders that, with ball bearings of proper size, correctly mounted, not only may a very high degree of accuracy be obtained initially, but this accuracy may be maintained without change over a satisfactorily long period of service. So great are the advantages of the applications now made, in lower servicing costs, increased accuracy and longer life, that first costs in most instances fade into a minor consideration.

Ball Bearings for Milling Machine Spindles

In milling machines, it is particularly essential that the rigidity of the spindle be as nearly absolute as possible in an axial direction as well as radially. Thus when taking heavy facing cuts, variation in the plane of the cut, due to endwise motion of the spindle, is kept within exceedingly close limits. This is true of the milling machine spindle illustrated in Fig. 5. Where, as in this case, the spindle is quite long, and the best arrangement of gears or other parts is a limiting factor in the location of the bearings, four bearings may be used to advantage. While the mounting principle is identical with other applications shown, a somewhat different method is employed in pre-loading the front bearing. The adapter in which these two bearings are fitted is machined with a wide spacing shoulder against which the faces of the bearing outer rings are located. The spacer separating the inner rings is then accurately faced to such a length that when the bearings are tightly clamped through the inner rings, they are placed under an initial load sufficient to give the required rigidity when doing the heaviest work.

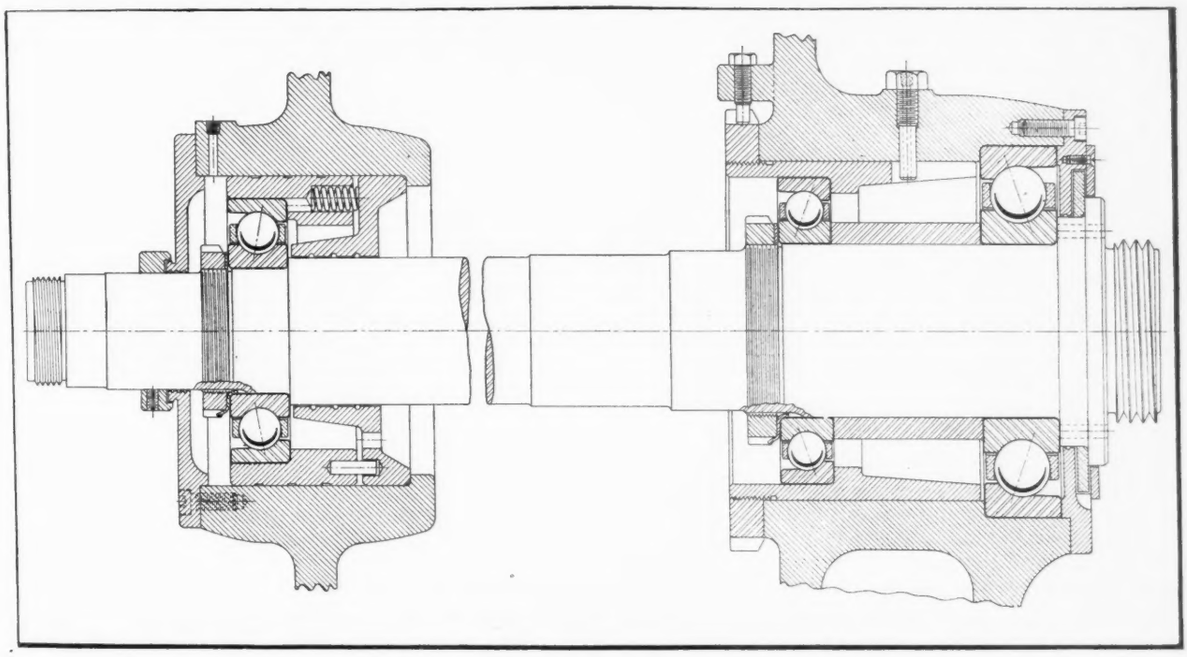


Fig. 4. Spindle with a Third Bearing for Support Against Deflection

Although the use of two bearings at the rear is advisable in a spindle the proportions of which are comparable to that illustrated, and it is necessary that they be applied under a definite thrust load in order to furnish positive radial support, it is essential that their adjustment be independent of the adjustment for the front bearings. This is accomplished by means of the spring-loaded sleeves in which the rear bearings are carried. Note that the sleeves are so keyed that rotation is prevented.

Ball Bearings for Small High-speed Spindles

Smaller, higher speed machines, such as multiple-spindle automatics, have benefited to a marked de-

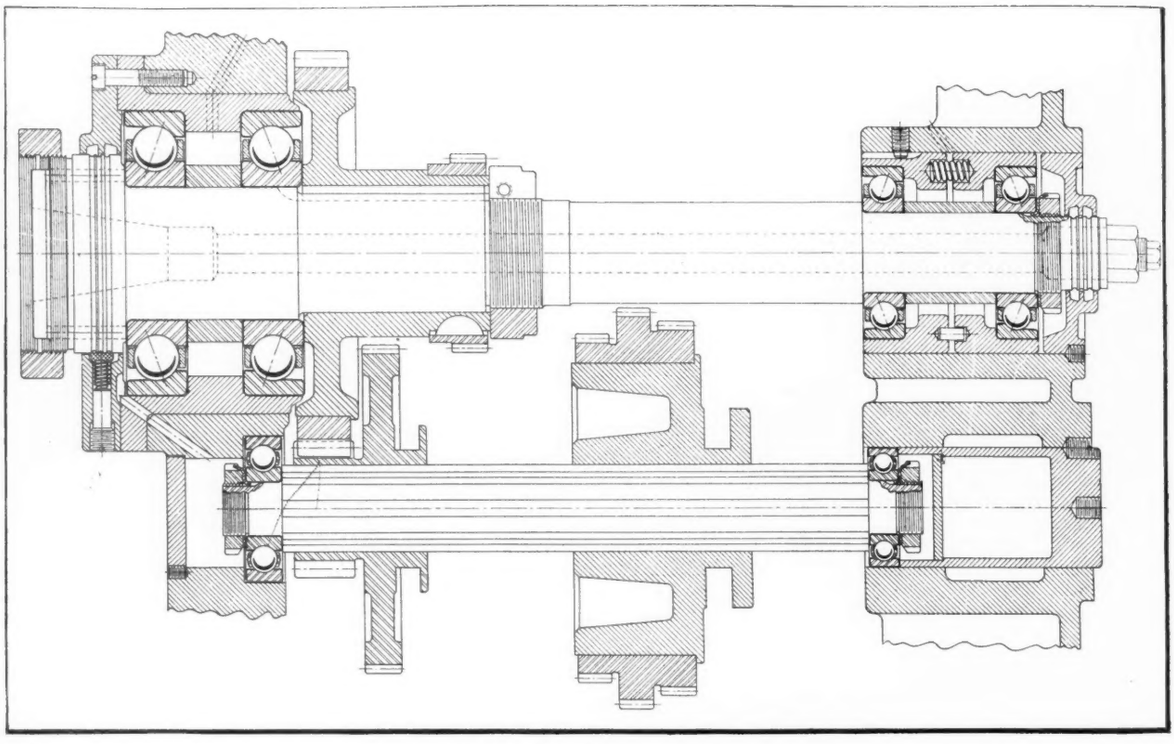


Fig. 5. Milling Machine Spindle Equipped with Ball Bearings

gree by the use of ball bearings. A typical mounting for a six-spindle automatic is shown in Fig. 6. With this construction, at speeds of 3000 to 3600 revolutions per minute, the ball bearings not only successfully overcome the heating experienced with bearings previously used, but also readily eliminate chatter. In this instance, the front and rear bearings on each spindle are opposed to each other under the initial load, and the center bearing is spring-loaded.

Most of the spindles described are grease-lubricated; however, the design shown in Fig. 6 lends itself to a simple but effective oiling system. By this system or method, the chamber surrounding the central spindle drive shaft is given a suitable supply of oil. This oil runs from the chamber through drilled holes into the bearings of the lowest spindle. As the drum is indexed around, the oil in this spindle gradually drains back into the central chamber, leaving enough in the bearings, however, to provide ample lubrication when they reach the working position.

Grinding Machine Installations

In various types of grinding machines it has been found that ball bearings not only materially improve the quality of the grinding, but also increase the total output capacity to an appreciable extent. In other words, it is possible to operate over long periods at maximum capacity without experiencing difficulty in maintaining a uniformly high finish and close limits.

The heavy cylindrical grinder spindle shown in Fig. 7 is representative of the class of tool referred

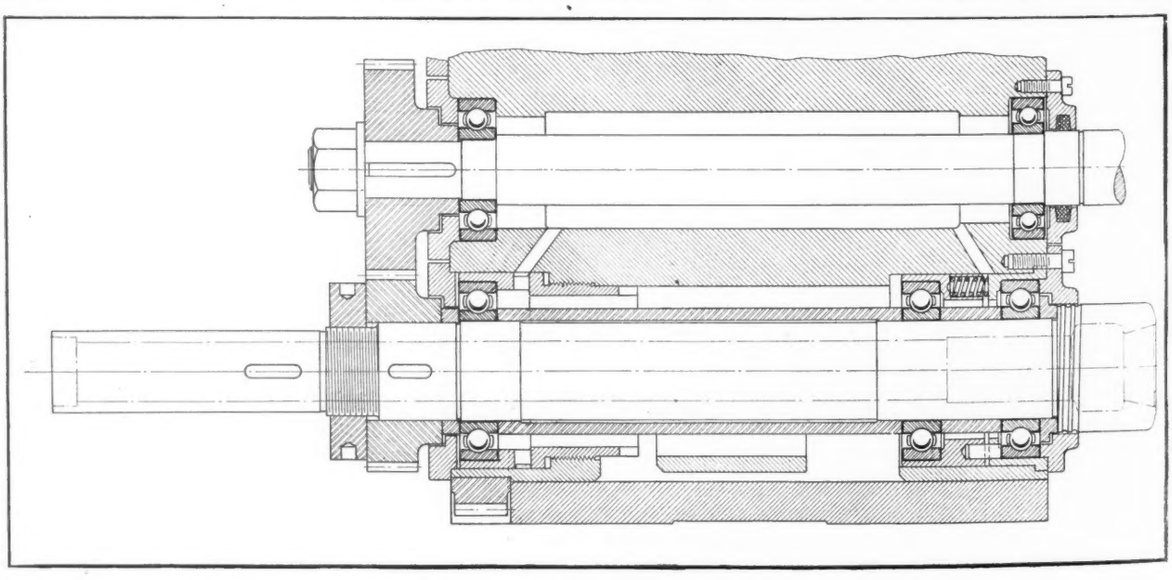


Fig. 6. Typical Ball Bearing Mounting for Six-spindle Automatic

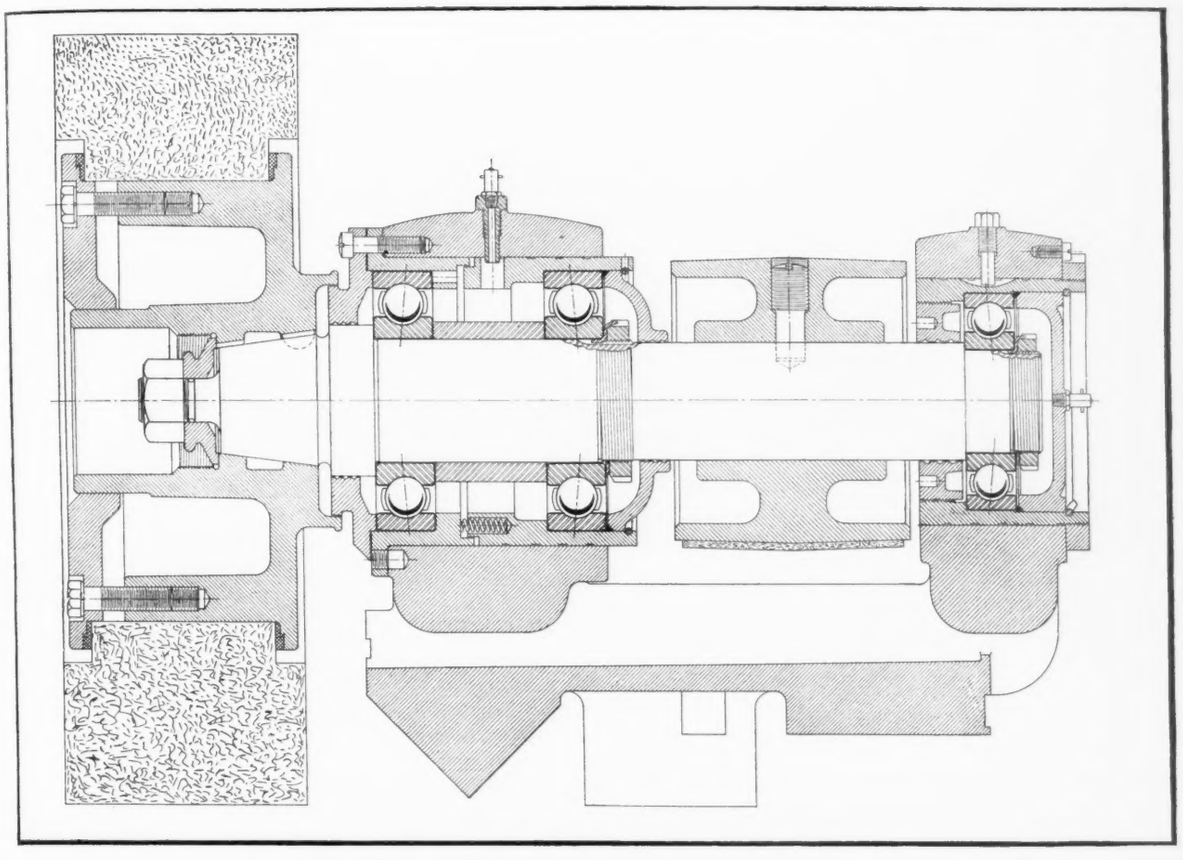


Fig. 7. Heavy Grinder Spindle Mounted on Ball Bearings

to. Note that this application is so arranged that all bearings and bearing mounting parts may be completely assembled on the bench, and then introduced into the main housing as a unit. This is advantageous both as regards speed and accuracy of assembly. Improvements associated with the use of ball bearings are not restricted to those machines designed to work within exceedingly close limits. A spindle employed in a large tool adapted to heavier, rougher grinding is shown in Fig. 8. This grinder carries a 30-inch segmental wheel weighing 400 pounds. On one job it is used constantly in facing heavy cast-iron plates, where, with a 1/16-inch cut, it removes 160 pounds of metal an hour. The spindle runs cool and without chatter.

Although this is a large spindle and the distance between the front and rear bearings is considerable, the temperature variation when operating is so slight as to warrant opposing these two bearings

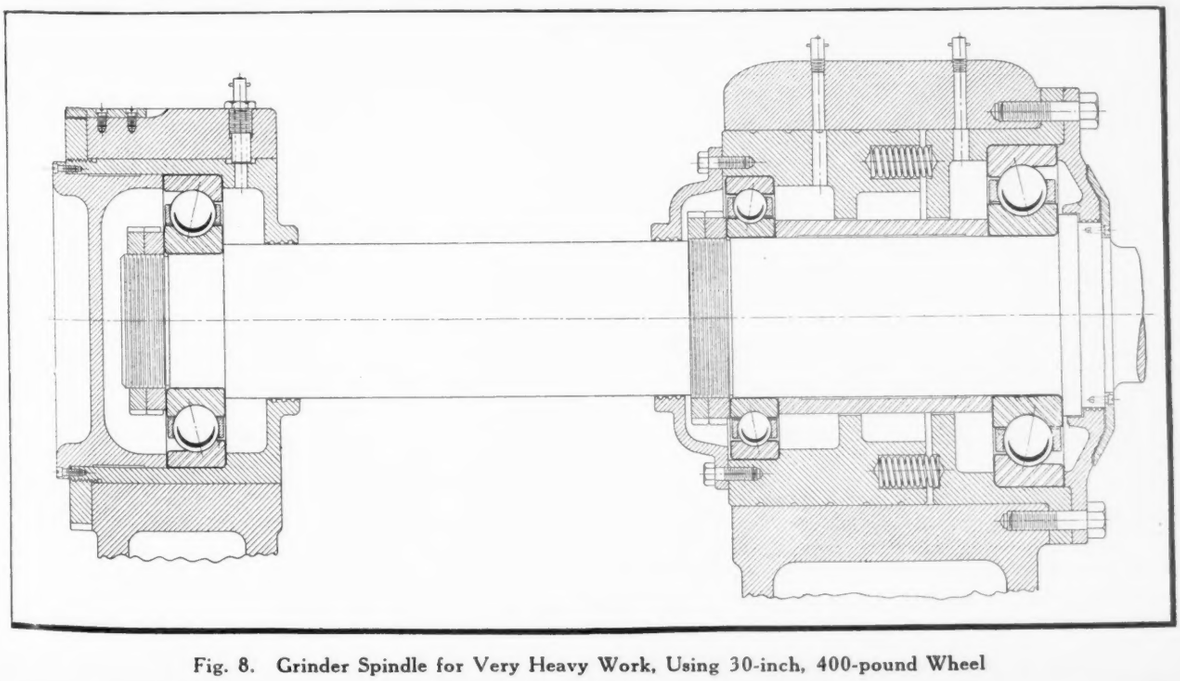


Fig. 8. Grinder Spindle for Very Heavy Work, Using 30-inch, 400-pound Wheel

under the pre-load condition. It will be observed, however, that should any unusual expansion take place, the tension upon the opposed bearings would be relieved rather than increased. The comparatively wide spacing between the front and intermediate bearings places the latter bearing at a point on the spindle where it can give the most effective anti-whip support.

Essential Points in the Application of Ball Bearings

The interest in ball bearing equipped spindles and in other parts of comparable characteristics has reached such a point that it is believed the foregoing brief descriptions as well as the following summary will be of interest, especially to those who have not yet taken advantage of the engineering recommendation service of any of the ball bearing manufacturers.

1. The bearings must be so applied that a definite initial thrust load may be imposed, and whatever method is used, a suitable locking device should be incorporated to insure positive maintenance of the pre-loaded condition when in service.

2. It is essential that the fit of bearings, sleeves and other parts be accomplished with a proper degree of accuracy. In general, ball bearing inner rings should be applied with a firm press fit, and the outer races should have a light press fit in the sleeves or directly in the main frame, as the case may require. Stationary sleeves should be pressed lightly in place and means for withdrawal should be provided. Sleeves movable in the main frame for adjustment purposes should be very closely fitted and should present an ample surface in contact with the housing bore, so as to prevent radial looseness. Faces of bearing spacers and shoulders against which the bearings are to be located should be square and also true with the axis of the spindle.

3. Bearings must be of ample size. Nothing is gained by the use of any kind of ball bearing in sizes so small that a suddenly applied overload would cause excessive deformation in the rolling elements and races.

4. Housing frames and the main spindles themselves should be of generous proportions to insure rigidity. The rigidity provided by properly applied bearings is useless if the parts on or in which they are mounted are of such proportions that they may be seriously deflected under load conditions.

Although the machine work in mounting ball bearings on main spindles necessarily calls for greater accuracy and closer fits than is the case in general applications, it will be found that first costs are frequently little if any higher than for the best mountings previously used. This is especially true where machine tools are designed expressly for ball bearings and not merely altered to accommodate them. Early service costs for the machine manufacturer, and maintenance costs for the machine tool buyer, which were not infrequently a cause of lower profits to both, have been substantially reduced by employing ball bearing spindles.

* * *

WHERE SALESMEN ARE NOT KEPT WAITING

On the editorial page of June MACHINERY there was a brief paragraph headed "Welcome Salesmen." The ideas expressed in this paragraph are finding a practical application at the plant of the Oakland Motor Car Co. At this plant, systematic efforts are being made to eliminate any waste of salesmen's time by giving them attention almost immediately.

The supervisor of purchases, Charles O. Miller, arranged to have the clerk at the information desk by the entrance check the time of arrival of all callers wishing to see members of the purchasing department, and to note the time that each caller had to wait before he was able to see the man he wanted. After two months of operation, the average waiting time has been less than four minutes. The best day's average was but 1 1/2 minutes. This is all the more remarkable in view of the fact that on an average over 100 outside visitors are seen daily by the purchasing department of the company.

In the lobby is a sign reading as follows: "Our suppliers are as necessary to us as our customers. We want to see you. You are entitled to a prompt interview or a reason why you are kept waiting. Do not hesitate to call on the information clerk if you are kept waiting. Please remember the man following you."

Once in the buyer's office, the salesman finds another framed courtesy sign, reading as follows: "It is our aim to have the purchasing department callers delayed as little as possible in seeking an interview. It is the duty of each buyer to see salesmen promptly. It is also his duty to see that salesmen have the proper regard for other salesmen who may be waiting their turn."

There is also a "score card" posted in the lobby daily, telling the number of salesmen interviewed the previous day and the average time each waited. One day, for example, the information given was that 75 salesmen had been interviewed and that the average waiting time had been 1.8 minutes. The total number of salesmen seen in one month is also given. One month this number was 2526.

* * *

Exports of automobiles and trucks to Europe are constantly increasing. Last year over 153,000 American passenger cars and trucks were exported.

The Automobile Tool Engineer

In no other industrial field have so great and rapid changes been made in the product manufactured during the last twenty-five years as in the automotive industry. Compare the cars built only twenty years ago with present-day models. It is almost inconceivable to middle-aged men of today that they ever rode in the vehicles of the earlier date. For this great advance, the automobile designer is justly entitled to credit, but the progress in this field has been made possible only through cooperation between the automobile designer, the tool engineer, and the machine tool builder. In an article in October MACHINERY, Charles B. Ekdahl, chief tool engineer of the Pierce-Arrow Motor Car Co., will briefly outline the work of a tool engineer and point out the contribution that he has made to the rapid development and use of automobiles.

MACHINERY'S Data Sheet No. 137, New Series, September, 1928

HORSEPOWER OF NON-METALLIC SPUR GEARS

The following method of computing the horsepower of non-metallic spur gears composed of laminated phenolic materials or rawhide is the recommended practice of the American Gear Manufacturers' Association. In computing the power-transmitting capacity, use the formula below. The notation (Association's standard) is given in the following:

HP = horsepower;
SWS = safe working stress of material (varies with speed—see values in table below);
FW = face width in inches;
Y = constant depending upon number of teeth (see values of Y in table below);
PLV = pitch-line velocity in feet per minute; and
DP = diametral pitch.

$$HP = \frac{0.000095 \times SWS \times FW \times Y \times PLV}{DP}$$

SAFE WORKING STRESSES FOR DIFFERENT SPEEDS

PLV	SWS	PLV	SWS	PLV	SWS
100	4500	700	2500	1700	1974
150	4071	800	2400	1800	1950
200	3750	900	2318	1900	1929
250	3500	1000	2250	2000	1909
300	3300	1100	2192	2200	1875
350	3136	1200	2143	2300	1860
400	3000	1300	2100	2400	1846
450	2885	1400	2063	2600	1821
500	2786	1500	2029	2800	1800
600	2625	1600	2000	3000	1781

$$SWS = \frac{150}{200 + PLV} + 0.25 \times 6000$$

VALUES OF Y FOR 14 1/2-DEGREE INVOLUTE TEETH

No. of Teeth	Y	No. of Teeth	Y	No. of Teeth	Y
12	0.067	20	0.090	43	0.110
13	0.070	21	0.092	50	0.112
14	0.072	23	0.094	60	0.114
15	0.075	25	0.097	75	0.116
16	0.077	27	0.100	100	0.118
17	0.080	30	0.102	150	0.120
18	0.083	34	0.104	300	0.122
19	0.087	38	0.107	rack	0.124

SCREWS FOR POWER TRANSMISSION

TYPES OF SCREWS USED AND POWER TRANSMISSION FORMULAS

Single vs. Multiple Threads—Multiple-thread screws are much more efficient than single-thread screws, as the efficiency is affected by the helix angle of the thread; however, the single-threaded type is often preferable owing to its mechanical advantage, as compared with the multiple-threaded form. Thus a heavier load can be moved by a single-threaded screw than by a multiple-threaded one, assuming that the screw diameters and the force applied are the same in each case.

Notation Used in Formulas—The notation which follows applies to the formulas on this Data Sheet.

F = force applied at end of lever arm;
L = load moved by screw;
R = length of lever arm;
l = lead of screw thread;
r = mean or pitch radius of screw; and
μ = coefficient of friction.

Force Required to Turn Screw—In determining the force that must be applied at the end of a given lever arm in order to turn a screw (or nut surrounding it), there are two conditions to be considered: (1) When rotation is such that the load *resists* the movement of the screw, as in raising a load with a screw jack; (2) when rotation is such that the load *assists* the movement of the screw, as in lowering a load.

When load resists screw movement:

$$F = L \times \frac{l + 2r \times 3.1416\mu}{2r \times 3.1416 - \mu l} \times \frac{r}{R}$$

When load assists screw movement:

$$F = L \times \frac{2r \times 3.1416\mu - l}{2r \times 3.1416 + \mu l} \times \frac{r}{R}$$

If lead l is large in proportion to the diameter so that the helix angle is large, F will have a negative value, which indicates that the screw will turn due to the load alone, unless prevented by a force F which is great enough to prevent rotation of a non-locking screw.

Coefficients of Friction—According to experiments by Professor Kingsbury made with square-threaded screws, a coefficient of 0.10 is about right for pressures less than 3000 pounds per square inch and velocities above 50 feet per minute, assuming that fair lubrication is maintained. If the pressures vary from 3000 to 10,000 pounds per square inch, a coefficient of 0.15 is recommended for low velocities. The coefficient of friction varies according to lubrication and the materials used for the screw and nut. For pressures of 3000 pounds per square inch, using heavy machinery oil as a lubricant, the coefficients were as follows:

Mild steel screw and cast-iron nut, 0.132; mild steel nut, 0.147; cast-brass nut, 0.127.

For pressures of 10,000 pounds per square inch, using a mild steel screw, the coefficients were, for a cast-iron nut, 0.136; for a mild steel nut, 0.141; for a cast-brass nut, 0.136.

For dry screws, the coefficient may be 0.3 to 0.4 or higher.

Coefficient of Friction for Angular Thread Forms—Frictional resistance is proportional to the normal pressure, and for a thread of angular form the increase in the coefficient of friction is equivalent practically to $\mu \sec \beta$, in which β equals one-half the included thread angle; hence, for a U. S. standard thread, a coefficient of 1.155μ may be used.

Effect of Helix Angle on Efficiency—The efficiency between a screw and nut increases quite rapidly for helix angles up to 10 or 15 degrees (measured from a plane perpendicular to the screw axis). The efficiency remains nearly constant for angles between about 25 and 65 degrees, and the angle of maximum efficiency is between 40 and 50 degrees.

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MACHINERY'S Data Sheet No. 138, New Series, September, 1928

Notes and Comment on Engineering Topics

The first public exhibition of gages of which there is any record was at the Centennial Exposition in Philadelphia in 1876, where plug and ring gages, micrometers, and measuring machines were shown.

A process has been developed in Germany for coloring the wood of growing trees. Holes are drilled at the base of the trunk and these are filled with a suitable dye in fluid form. The circulatory system of the tree itself does the work of distributing the dye, thereby uniformly coloring the wood throughout the tree.

In a recent number of *La Technique Moderne*, it is mentioned that the French Government is planning to investigate the construction of a railroad across the Sahara Desert. If authorized, the plans contemplate the completion of such a railroad about 1936. The length of the railway will be 1735 miles, and the estimated cost about $20,000 per mile.

According to *Grits and Grinds*, published by the Norton Co., Worcester, Mass., it is estimated that approximately $20,000,000 worth of grinding wheels were used in the automobile and automotive parts industries last year. Of this vast amount of grinding wheels, Detroit, being the chief center of automobile production, used more than any other locality.

The Republic of Colombia is the largest exporter of gold and platinum in South America. There are also vast oil deposits within its boundaries, although the oil production is, as yet, in its infancy. The mineral wealth of Colombia has never been adequately explored, but present indications are that it is very rich in minerals, and especially in precious metals.

The world's deepest mine is the one known as the Village Deep Gold Mine, south of Johannesburg in South Africa. This mine has reached a vertical depth of 7630 feet below the surface of the ground at the mouth of the mine. This means that the extreme depth of the mine is 1800 feet below sea level. It is planned to conduct operations in this mine at still greater depths.

A Swedish engineer, John Grafstrom, of Gothenburg, Sweden, has recently invented a device which automatically registers and draws on a chart the course of a ship at sea. The device is connected with a gyroscopic compass and with the log, and by recording with mathematical correctness on the nautical chart the exact movements of the ship, it enables the officers to see the correct position of the vessel at any moment.

An automatic metering device by which it is possible to obtain the readings of electric meters and instruments in all parts of the power system on a single receiving apparatus located at some central point has recently been placed on the market by the General Electric Co., Schenectady, N. Y. The method is known as "telemetering" and operates over a single pair of wires, the receiver being actuated by impulses sent out by relays connected with the outlying meters. Important readings, such as voltage, amperes, kilowatts, and frequency may thus be transmitted to a central receiving instrument from all parts of the system.

The increased manufacture of corrosion-resisting steels containing chromium has been responsible for a considerable increase in the world consumption of that metal. The production of chromium in 1926 was more than double that in 1913. The bulk of chromium ores is obtained in British and French territories. Rhodesia and India together, from 1921 to 1925, supplied 65 per cent of the total world output of chromium ores, and New Caledonia, the French island colony in the Pacific Ocean, about 12 per cent. Other chrome ore producing countries are Greece, Turkey, and Cuba. The newly developed art of chromium plating is likely to still further increase the demand for chromium.

Russia is in a position to develop a transportation system in which railroad and motor truck transportation may be coordinated into a perfect system. The Russian railroad system, compared with the size of the country, is comparatively small, and while main trunk lines radiate throughout the country, few smaller railroad feeder lines are as yet built. Russia is now in a position to build highway feeder lines for bus and motor truck transportation as adjuncts to its trunk railroad lines, instead of attempting to build numerous short railroad feeder lines such as were constructed in this country in the days before the automobile, many of which have not proved financially profitable.

Eight awards have been made for the next college year from the fellowship fund established by the Charles A. Coffin Foundation of the General Electric Co., to encourage research in electricity, physics, and physical chemistry. These fellowships are given to students who, without aid, would be unable to undertake such work. Each student is permitted to choose the institution at which he wishes to continue his studies. The total number of awards granted since the fellowships were established in 1922 is forty-seven. The men receiving these awards this year are from seven different states—from Massachusetts to Utah. The foundation endeavors in this way to make the awards truly national in character.

Current Editorial Comment

In the Machine-building and Kindred Industries

HAZARDOUS PRODUCTION GUARANTEES

Many buyers of machine tools, especially in the high-production industries, request or require the machine tool builder to guarantee the production of his machine in the customer's shop. Some machine tool builders do this, but a few decline to do so on the ground that they cannot guarantee production in a shop where they have no control over the conditions under which the machine will be operated. The latter say that if the customer will send to their shop the castings or forgings to be operated upon they will agree to furnish a machine that will finish a certain number of parts per hour, of the kind submitted, when the machine is operated in accordance with the methods that the builder recommends, but if the shop conditions in the buyer's plant are such that he cannot take full advantage of the capacity of the machine, they cannot guarantee production in his shop.

Frequently, when complaints are made that machines are not producing the number of pieces per hour, or day, that the machine tool builder has guaranteed, investigation shows that the material in the castings or forgings operated upon is not uniform and that much harder castings or tougher forgings are being used than the samples submitted to the machine tool builder when he made his estimate. The best that the machine tool builder can do is to state the output of the machine when operated under favorable shop conditions on a uniform quality of material.

* * *

THE AIM OF STANDARDIZATION

Probably no single activity in the engineering field commands more attention at the present time than the standardization of machine parts, tools and mechanical appliances. The meetings of many trade associations are devoted largely to standardization problems. The national engineering societies have whole departments of their office organizations engaged in standardization work, and expend large sums of money on this activity. At their meetings more and more time is given to standardization committee conferences, which often result in great economies in the production and distribution of manufactured products.

In all this work, however, one point should not be forgotten: Standardization is intended to bring about interchangeability of the product, but it should not act as a brake on development work, or prevent improvements in quality. In standardizing tools, for example, only dimensions which permit interchangeability of tools of different makes should be standardized. Design features that do not interfere with interchangeability, quality of material used, and production methods, should be left wholly to the judgment of each manufacturer of these tools.

Any standardization that goes further than merely to provide for interchangeability will defeat its own purpose, because manufacturers will refuse to adopt standards that interfere with the production of what each believes to be the best possible tool that he can make and sell.

* * *

NEW DEVICES FOR STUDYING MECHANISMS IN MOTION

One of the principal difficulties in detecting and remedying mechanical defects in machines or mechanisms that operate at high speeds, is the impossibility of observing the action of the rapidly moving parts with the naked eye. Frequently it is obvious that there is a defect in a mechanism, because it fails to function at high speeds in the same manner as it does at low velocities; but the cause is difficult to determine, because it cannot be observed at high speeds.

This difficulty of the machine designer is now gradually being overcome, and several devices have recently been developed by the use of which it is possible to study high-speed mechanisms under actual working conditions. These devices, the operation of which depends mainly upon the possibility of interrupting an electric current during a small fraction of a second, make it feasible to illuminate the moving parts at extremely brief intervals so that, to the eye, it appears as if the mechanism were running at a very slow speed, or, if desired, as if it were stationary; but the picture presented to the eye will be that of the mechanism when it is running at high speed.

These new devices open up an entirely new field for the study of the action of mechanical designs, and will prove extremely valuable in research work on cutting tools, gear tooth action, cam-operated mechanisms, unbalanced revolving parts, and many similar moving mechanisms, that heretofore have presented problems difficult of solution.

* * *

DON'T OVERLOOK SMALL SAVINGS

A substantial saving in power costs may be obtained in many shops by lining up the lineshaft bearings at regular intervals. A considerable reduction in the friction load can be obtained by careful alignment. This practice is not as general as it should be, because the cost of the power lost through inaccurate alignment cannot be determined easily, and tests to show the actual loss incurred are expensive and difficult to make. In a few instances where tests have been made, the value of accurate alignment has been definitely proved.

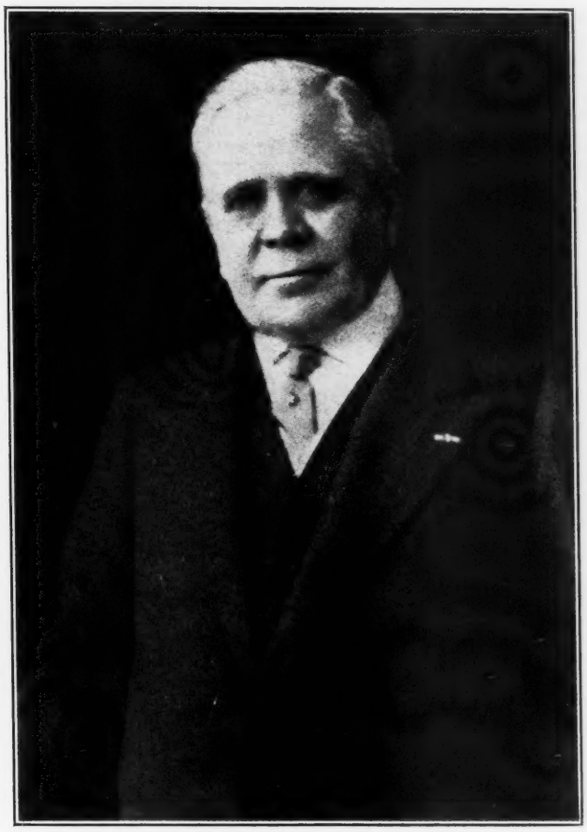
Small savings like this should not be overlooked. Often the difference between profit and loss at the end of the year is merely the aggregate of a great many small economies.

Business Success and Human Relations

By CLARENCE H. HOWARD, President, Commonwealth Steel Co., Granite City, Ill.

HUMAN engineering has only recently been recognized as a field of knowledge in which definite principles govern the same as in the physical fields of engineering. Human engineering is actually of the same nature as mechanical engineering in that it arrives at a solution of its problems in much the same way.

How does mechanical engineering arrive at results? It solves specific problems by working them out in the light of universally accepted principles. It knows what it is doing. It does not proceed on mere opinions, beliefs, or enthusiasm. When my plant is called upon to supply certain parts for a locomotive, the definite requirements to be met are put before the engineering staff—the weight of the locomotive to be built, the tractive power, the speed that it is expected to make and any special conditions of construction are all carefully considered. When all this information has been fully digested, the rest of the work consists merely in the application of well-known mechanical engineering principles.



Clarence H. Howard, President, Commonwealth Steel Co.

These principles are the property alike of all engineers. No one can monopolize them. They are applicable everywhere. An engineer educated in the United States can apply these principles with equal success in South Africa. The engineer knows that he must stick to these engineering principles, and the finished product is the result of the harmonious relations of all the principles involved in the design of a mechanism or structure.

Do We Apply Similar Principles in Human Relations in Industry?

When we step out of the mechanical realm into the realm of human relations, what a contrast we find. How imperfect our efforts are. What a difference there is between the confident, efficient way in which we go ahead in mechanical engineering and our blunders in the realm of human engineering.

Nevertheless, in order to be successful in human engineering we must do exactly what we do in other fields of engineering. In mechanical engineering, if you are going to design a structure from steel, you begin by finding out everything that is known about steel, and then proceed to treat the steel as steel. You find out what principles govern its behavior under different conditions. You do not say that the steel ought to have certain strength, certain physical properties, and certain appearance. You have to accept as a fact that the tensile strength of a certain kind of steel is so many pounds per square inch, that it has a certain percentage of elongation, and that, when finished in a certain way, it will have a certain appearance. These qualities are essential elements of the structure of steel and are not subject to your own opinions, whims or wishes.

Now, the first essential in human engineering is to be willing and able to deal with men as men, just as in mechanical engineering we deal with steel as steel. The first step is to find out the principles that govern the actions of men when employed in useful tasks. These principles do not depend on our own wishes or opinions, but depend on definite characteristics in the men that make up an organization. When we have determined these principles and are willing to make intelligent use of our knowledge of them, we can go ahead with confidence in establishing such human relations in an industrial enterprise as will make the enterprise permanently successful.

The First Essential in the Successful Handling of Men

The first essential in the treatment of men as men is to remember that the all-important thing about man is his ability to think. The appeal of human engineering must always be to a man's mind, and it is important to remember that the success of an enterprise depends more upon enlisting the cooperation of men's minds in that enterprise, than it does upon machinery and tools. The great mistake which so many managers make is to think that they can deal with human beings as if they were mere cogs in a wheel, mere

machines that have no thoughts, ideas, ambitions, or pride of their own.

An organization, to be most effective, must have a common objective—one which all the men in the organization can see and understand. This objective should be so coupled with individual benefits and group benefits as to furnish the most powerful incentive toward individual and group effort.

Look at this fundamental requirement in the light of the ordinary principles of mechanical engineering. Did you ever see a successful mechanical device in which every part was not shaped and placed for the accomplishment of a definite object? In an efficient machine the gears mesh properly, the bearings run true, and all parts have a definite function to perform. Parts that have nothing to do with the work for which the machine is constructed are not present.

Now, what sort of engineering is it that designs mechanical devices with the fullest recognition of the principles of coordination and interdependence, and entirely ignores these principles in human relations? Men are much more precious material than steel. Is it too much to ask that a human organization be built with the same scrupulous attention to the fundamental principles that are used in the construction of a well-designed locomotive?

Character Building is a Function of Management

In organization discipline, again the human engineer can learn from his mechanical brother. Here is an ignorant, untrained man who is taken into a mill as an oiler. Partly through ignorance and partly through carelessness, he permits dust and sand to get into the bearings of a shaft that is running under a heavy load at a high speed. Before long the bearing is running hot. Suppose that the engineer in charge gives the oiler a cursing, "riding" him harder and harder until the man loses his self-control. The man then ceases to be a thinking, reasoning being. That engineer, in doing this, has done exactly what the man whom he is reproving did, and under circumstances which render it far more blameworthy. He has put sand into the bearings of an important human relationship. He has increased friction where he should have avoided it. Suppose that instead of merely scolding, he patiently and kindly instructs. In so doing, he raises the man higher than he was; he up-builds his character.

The Object of an Industrial Organization is to be Useful

High individual efficiency in an organization brings the greatest service to the customers through the company's products. When the service rendered is commensurate with the prices charged, confidence is earned and success is assured. Such service is expressed through safety, efficiency and economy; and character building is its goal. It is service when a man profits *with* his fellowman and the community, but not *at* their expense.

How is the highest individual efficiency to be obtained? A skillful man not willing, or a willing man not skillful, can but half meet the requirements for giving full service to himself, his company, or the community. To develop skillful men through fair dealing and friendly interest, to develop the cooperative spirit, is the task of the human engineer—the manager—of an industrial undertaking.

Human engineering is one of the most important factors in reducing labor turnover. It teaches that you cannot receive anything with a closed hand—you must open up first. This makes evident that the hole you make in giving is the hole you must receive through. People who give little receive little, but the fellow who is willing to do big, broad, charitable things and has a true sense of service to his fellowman, makes a great big hole in giving and therefore receives countless blessings. Consequently, it is plain that we cannot make or buy our blessings; we can only provide channels through which they may come to us from the one Source of all blessings.

In these United States we do not believe that arbitrary force should regulate man; rather do we believe that righteousness should permeate both our laws and our industrial relations. Mankind will progress in proportion to the application we make of the Golden Rule in law, industry and commerce.

* * *

FALSE ECONOMY IN THE DRAFTING-ROOM

By R. H. KASPER

Requiring a number of blueprints of certain parts, the writer left some rough pencil sketches in the drafting-room from which the necessary drawings and tracings were to be made. Most of the parts could be drawn full size on a sheet about 10 by 12 inches. On calling for the tracings or blueprints some time later, it was found that the parts had been drawn to a reduced scale. When inquiries were made regarding this point, the writer was told that the object in making the drawings to a reduced scale was to cut down expenses and that tracing paper and blueprint paper cost money. Also that by reducing the size of the drawings, the prints could be made to fit a smaller folio, which was cheaper than the larger size.

Although the making of reduced-scale drawings of this kind is general practice in many drafting-rooms, it is, in the writer's opinion, false economy. Granting that there is a saving of material, the cost of the material saved in no way compares with the expense of making reduced-size drawings, nor with the time lost by the workmen in deciphering a blueprint that is reduced to such an extent that distinctness is sacrificed.

In the first place, dimension figures should be of a size that can be easily read by the workman having average eyesight. On reduced-scale drawings, owing to lack of space, the draftsman usually finds it necessary to reduce the size of the figures, so that, at a quick glance, one figure may be mistaken for another. Again, a dotted line may run close to a solid one; thus, the chances of error are greatly increased. It must also be considered that only one tracing is required, whereas hundreds of blueprints may be made from one tracing, and there are possibilities of errors creeping in each time a blueprint is used if the dimensions and details are not clear and distinct.

Machining Crankshaft Bearing Caps

SEVERAL high-production operations in machining automobile crankshaft bearing caps at the Continental Motors Corporation, Detroit, Mich., are described and illustrated in this article. In each of these operations, the bearings are machined in sets of two, the production of each machine averaging about thirty sets per hour. The caps are iron castings.

Fig. 1 shows the first operation performed on the bearing caps. It consists of milling the cylinder contact surface on an Ingersoll milling machine. The table rotates continuously and is equipped with

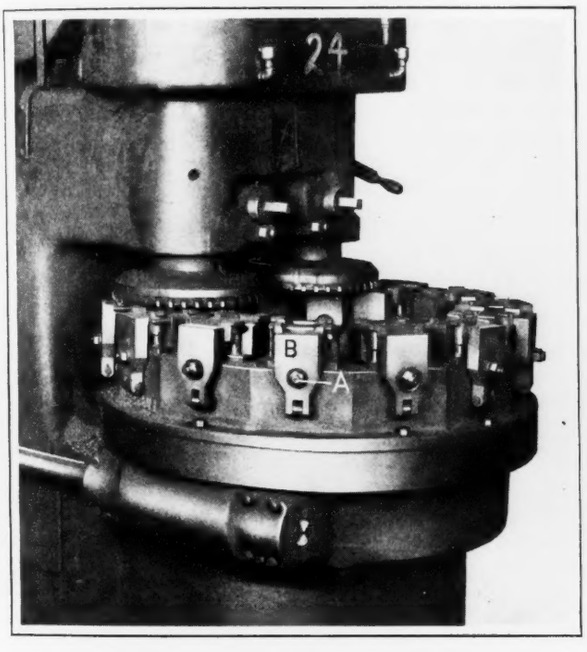


Fig. 1. Milling the Cylinder Contact Surfaces of Crankshaft Bearing Caps

fourteen work-holding fixtures in which twenty-eight caps can be loaded at one time. Each cap is accurately positioned for the operation by seating on two hardened plugs, and two caps are simultaneously clamped by applying a wrench to the corresponding nut *A*. This serves to draw clamp *B* and another similar clamp on the inside of the fixture, firmly against the two bearing caps.

Both cutters are about 16 inches in diameter. The one on the left removes about 1/16 inch of stock in a roughing cut, while the right-hand cutter takes off about 1/32 inch of stock to finish the surfaces.

Drilling the Bolt Holes

A Baush multiple-spindle drilling machine arranged with four groups of drills for simultaneously drilling two bolt holes in eight different caps, is illustrated in Fig. 2. There are eight jigs on the table, in each of which two caps may be clamped for the drilling. The table is indexed 180 degrees between each operation. With this arrangement there are always four jigs beneath the drills and four other jigs at the front of the machine; the latter may be reloaded for immediately indexing into position.

To unload the work from any of these jigs, a rod handle is quickly inserted into socket *A* and this socket is pulled downward to actuate a toggle mechanism and cause rods *B* to raise the jig bushing plate *C*. The finished work can then be replaced with new caps which are seated in blocks *D*. Socket *A* is then again raised to lower the jig bushing plate, so that it comes in contact with the previous-

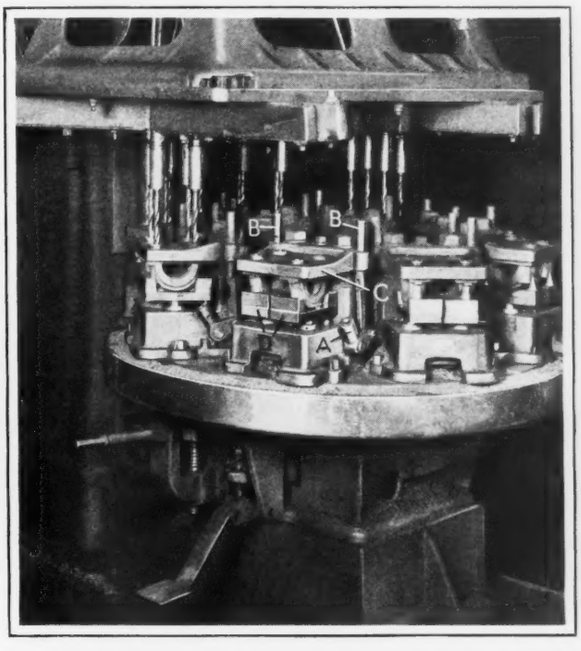


Fig. 2. Employing Sixteen Drills for Simultaneously Drilling Bolt Holes in Eight Bearing Caps

ly finished surfaces of the caps. Blocks *D* have an equalizing movement to insure a firm seating of the caps against the bushing plate, and after the work is firmly seated, the blocks are automatically locked in place for the operation. The drills are 17/32 inch in diameter.

Straddle-milling and Boring Operations

Each bearing cap is straddle-milled in the Ingersoll machine shown in Fig. 3. Seven rows of caps are milled simultaneously on each side as the revolving drum on which they are mounted carries them past fourteen milling cutters, about 18 inches in diameter, which are mounted on a shaft at the back of the machine. The surfaces of each cap milled in the first operation are clamped securely on hardened blocks of the revolving drum, one clamp serving to hold two caps in place. The caps are located sidewise by studs on the hardened blocks. About 1/16 inch of stock is removed from each face.

As the operator removes the finished caps from this machine, he places them in one of the channel-

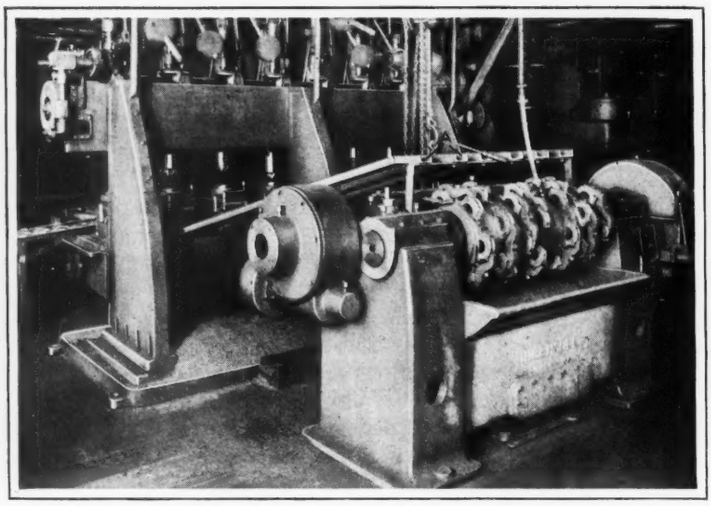


Fig. 3. Machines Employed for Straddle-milling and Boring Crankshaft Bearing Caps in Sets

iron chutes *A* so that they are carried by gravity to the operator of the seven-spindle machine seen in the background of the illustration. Here two caps are placed in a fixture and bored at one time by a tool approximately 3 inches in diameter. Chutes *A* save time in delivering work to the boring machine and eliminate considerable floor space which would otherwise be occupied by tote boxes. Channel-iron chutes are also used to carry the caps to machines employed subsequent to the boring operation.

* * *

ADJUSTABLE TOGGLE-JOINT SUB-PRESS FOR STAMPING SMALL PARTS

By ROBERT JULIAN

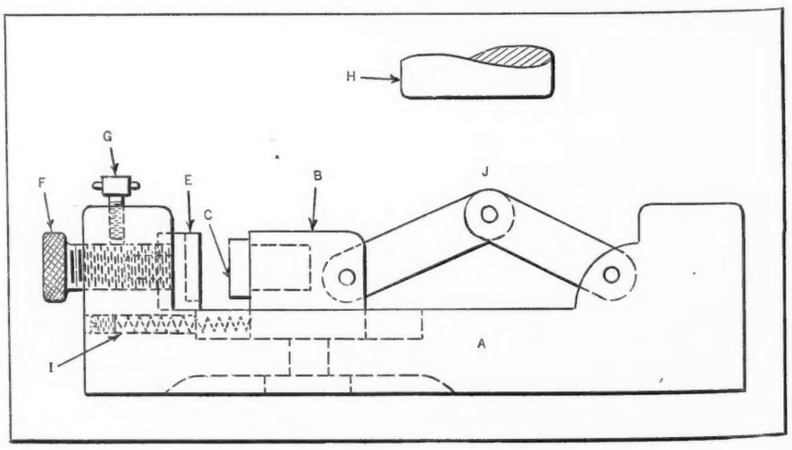
The adjustment of the stroke of a power press is usually obtained by means of a stud having a right-hand thread at one end and a left-hand thread at the other. When the stud is revolved, it shortens or lengthens the pitman according to the direction of rotation. The parts must be of heavy construction in order to withstand the strains imposed on them. It is obvious that the changing of the stroke 0.003 or 0.004 inch is a very tedious job.

When a very fine adjustment is required on small work, time can be saved by incorporating the means for obtaining the adjustment in the press tool itself. A tool of this kind, used for stamping the trademark, size, and other details on threading dies, knurling tools, etc., is shown in the accompanying illustration. As the marking is required to be only about 0.010 inch deep, a very sensitive adjustment is necessary.

Referring to the illustration, *A* is the die-block which is machined to receive a sliding member *B* through which a hole is bored for the cylindrical steel stamp *C*. A work-holder of semicircular shape is provided, which can be adjusted toward or away from the stamp by means of the fine-threaded screw *F*. When the required adjustment has been obtained, screw *F* is locked in place by a thumb-screw *G* which has a brass pad at the contact end.

A hardened steel hammer *H*, secured to the ram of the press, serves to operate the tool. There are two steel pieces which are hinged together at *J* to form a toggle joint. The end of one of the steel pieces is fastened to the die-block and the end of the other piece is secured to the sliding part *B*.

The operation of the stamp is as follows: The work to be marked is placed on the holder *E* and the press tripped. This causes hammer *H* to descend and flatten out the toggle joint at *J*, driving block *B* along the base *A* until the stamp strikes the work with sufficient force to produce the required marking. The depth of the marking can be accurately controlled by adjusting screw *F*. When hammer *H* ascends, the spring *I* causes the toggle joint to rise and resume its original position. The holder *E* and stamp *C* can be quickly changed for different jobs.



Adjustable Toggle-joint Sub-press for Stamping Small Parts

* * *

AN AID TO EFFICIENCY IN THE SHOP

By A. EYLES

Some shops regard the method of payment by results as the best stimulus toward increased efficiency and believe that this is all that is necessary. There are, however, other shops that attach even greater importance to good working conditions. One large elevator firm whose relations with its men have been quite satisfactory, has built a modern factory exceptional in every way, well lighted, well heated and ventilated, and surrounded by carefully tended flower-beds. These efforts have been supplemented by others indicating interest in the workers. As a result, good feeling between management and men has been maintained.

Another large firm whose relations with its employes are unusually good, attaches special importance to shop conditions and keeps every department clean, orderly, well lighted, and well heated. A cafeteria provides meals at cost, and aid is given to the employes in the handling of their own mutual benefit associations.

What MACHINERY'S Readers Think

Brief Contributions of General Interest in the Mechanical Field

WASTE IN SHOPS

A committee on waste in industries that presented a report some years ago, which I believe had a preface by the Secretary of Commerce, Mr. Hoover, pointed out that something like 50 per cent of the efforts of American industry went for naught because of preventable waste in one form or another. There is no question that there is a great deal of waste of both time and material, of power and labor, in every organization. Much of this could be saved if the employes were made to feel that it was to their interest to stop this waste. Unfortunately, in many shops, if employes make suggestions for improvements and particularly for the prevention of waste, these suggestions are resented by managers and foremen, because they consider it interference with their work and a reflection on their methods of management. The best efficiency can be obtained, however, only if suggestions for improvements are welcomed by everybody concerned, and the suggestions of the workers are given proper consideration. A. EYLES

SKILL AND BOOK KNOWLEDGE

The knowledge that a man gains from books and periodicals does not give him experience, but it shows him how to make use of the experience that he has already acquired. Knowledge creates faith in one's ability and without faith in one-self one cannot succeed. Today, knowledge of efficient shop equipment and the ability to apply such knowledge is a most essential requirement for advancement.

There are some workers who scoff at "theoretical" training. In doing so they overlook the fact that by studying, the slow process of obtaining knowledge by making mistakes may be avoided, and that the right method may be learned without expensive errors.

Many a worker would gladly fit himself by study for greater opportunities, but he does not know how or where to get his information. Where there are shop libraries he can obtain help from them. The technical journals, by suggestions and advice, are also ready to help anyone who cares to write to them for information. GEORGE H. GUNN

HOW BUSINESS MAY BE TURNED AWAY

I am a consulting engineer and as such frequently have occasion to place orders on behalf of my clients. Recently I called at a shop making an accessory used in machine shops, my object being to get detailed information about the device which I intended to order. I sent in my card to the manager, who also acts as sales manager, but he merely sent out word that he was too busy to see me. He probably thought that because I was a consulting engineer I wanted to get some business from him instead of placing business with him. The result was, of course, that I went to a competitor of his and obtained the equipment that I required.

I believe that it is very unwise for a manufacturer to turn away a visitor until he knows the object of the visit. Frequently business originates from the most unexpected sources and a man's card is not always an infallible indication of the reason why he is calling. OBSERVER

TOOL DESIGNERS NEED MACHINE DIMENSIONS

It is of great importance that a tool designer be furnished with sufficient data relating to the dimensions of machines for which tools are to be designed. Frequently, when tools are to be made for use on a certain machine, sufficient data to enable the tool designer to go ahead are not available. This makes it necessary for the designer to go out in the shop and take measurements of the machine. A loss of time results both to the operator, who may have to stop the machine he is operating, and to the designer.

To meet this condition, a list should be made up of all machines in the shop for which tools or special equipment may be needed, together with the serial number of the machine. The machine tool manufacturer would, in most cases, be able to furnish, upon request, a blueprint with sufficient data covering these machines; or if this cannot be obtained, measurements may be taken in the shop and a simple drawing prepared. These machine data sheets should be made up in a loose-leaf book with an index, so that they can be easily referred to by the tool designer. FRITZ L. KELLER

APPLYING OVERHEAD CHARGES

Many companies figure the overhead charge as a percentage of the direct labor cost. In shops where the labor cost is relatively high as compared with the total cost of production, or where the machine cost is practically the same for all the products manufactured, this method has proved satisfactory. It is simple and reduces clerical work.

In shops using a number of high-production or semi-automatic machines, direct labor cost is likely to be found an unreliable basis for figuring overhead. This is especially true if the high-production machines are used only on a part of the product being manufactured.

Under these conditions, it is better to figure the overhead as a percentage of the total cost of the direct labor and machine cost. The machine cost is obtained from the machine-hour rate, which should be calculated for each machine. This rate should include all the expenses incident to the operation of each individual machine and should cover depreciation, so as to provide for the replacement of the machine at the end of its profitable life.

This method has the advantage of giving a good idea of the relative importance of the factors that enter into the cost of production. In this way it is often easily demonstrated that production costs could be reduced by the use of more modern machine tools. W. L. ROMICK

REDUCING COSTS ON NEW MODELS

When a product is to be built for the first time, the manufacturer can avoid much needless expense, incident to unforeseen but necessary changes in design, by giving those who will handle the problem of manufacturing the new product an opportunity to examine the drawings before any of the parts are made. Frequently, the tool supervisor can suggest alterations which will permit the use of existing tools or fixtures, while the superintendent and the foremen may bring out points which are likely to cause trouble in production. The men in charge of the forge shop, pattern shop and foundry should also look over the drawings or blueprints with the view of avoiding difficulties in their department. In order to save time, unchecked prints may be used which may be marked with comments and notations before being returned to the designer.

The important point to remember is that a draftsman with a stout eraser can remove more metal in a few moments than a machinist can cut off in a day. The sensible and economical plan, therefore, is to obtain the suggestions and opinions of all concerned and to incorporate all worthwhile ideas in the design before a single piece is made. This will confine most of the development cost to the drawing-board, where changes are inexpensive; and the time required to perfect a product will also be reduced to a minimum. H. C. KLINE

SUGGESTION SYSTEMS IN SHOPS

Many managers would like to adopt a suggestion plan in their shops, but have thought it advisable not to do so because of certain difficulties likely to be encountered. The writer would like to state that while a suggestion system may have both advantages and drawbacks, the good features outweigh the objectionable ones by a large margin, if the plan is intelligently applied. The following essentials are necessary to make a success of the plan:

1. The awards must be generous. Niggardly awards destroy the value of a suggestion plan.
2. The official whose duty it is to supervise and handle the system must be very tactful.
3. Publicity relating to the plan must be placed constantly before the employes or enthusiasm will lag. One of the best methods is to post notices of the names of those who have made successful suggestions, each month, accompanied by the amount of the award and a brief description of the suggestion.

The savings effected by a good suggestion plan are usually sufficient to pay expenses and still bring a worthwhile return to the business. Furthermore, such a plan often brings out hidden talent that would not otherwise be discovered. It is surprising that suggestion plans are not adopted to a greater extent than they are in view of the success that has been experienced with such plans by several large firms. A. CADDIE

DESIGNING IS NOT ALL ENGINEERING

Experienced men often depart from recognized practices because years of battling with hard facts have taught them the wisdom of considering influences that are quite apart from technically correct procedure. Countless 1/2-inch set-screws have been specified in place of 1/4-inch screws, because the class of labor that would encounter the screws was entirely "too strong" to be trusted with the size that was correct according to the rules of machine design.

Some years ago, a feature of design was persistently stressed in the advertisements of a certain maker. This maker knew from experience that operators hammer up machine vise corners badly in setting to an angle or in squaring up the vise to right-angle positions. It is a very objectionable practice, but one hard to change, and so this manufacturer cast heavy lugs on his vises at the two points most likely to be battered, and then drew the attention of all machinists to them—lugs that could be battered without damage to sliding parts.

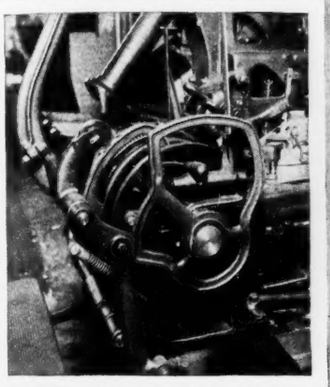
A combination square and miter tool for carpenters' use, made of drawn steel parts, was highly polished before nickel-plating. The tool never "took" with the trade until the finish was changed from polished nickel to a dull finish. The dull nickel did not reflect the bright sunlight in the objectionable manner that polished nickel did under actual working conditions. DONALD A. HAMPSON

PRICE VERSUS EXPERIENCE

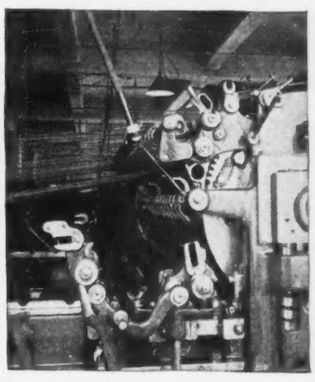
There is a tendency on the part of some purchasing agents to substitute the "just-as-good" article for one of proved value. While it is the duty of those entrusted with the expenditure of money to use it judiciously, it is also the shop man's duty to protect his company from becoming an experiment station for untried supplies and equipment. When a department head requests a specific item and designates it by its trade name, he usually knows from experience that this particular make will give him the best results. Few purchasing agents, unless they have studied the subject, are thoroughly familiar with power plant requirements.

Some time ago a power plant engineer had to replace several valves in a superheated steam line. He requisitioned three valves of a specific make which, from experience, he knew were best adapted to this purpose. The purchasing agent thought the price of the valves requisitioned too high and, by looking through catalogues, found a valve specified for the same duty, priced far below the make asked for. These valves were purchased, but had to be rejected by the engineer in charge, because of a state law prohibiting their use for that duty.

Quite often, time and money are wasted by deviating from a known standard. Too many times the cheaper article is, after all, the most expensive. When experience has taught a distinction between two products, price should be a secondary consideration. P. G. SWAYNE



Ingenious Mechanical Movements



AUTOMATIC NUT-TAPPING MACHINE

By J. E. FENNO

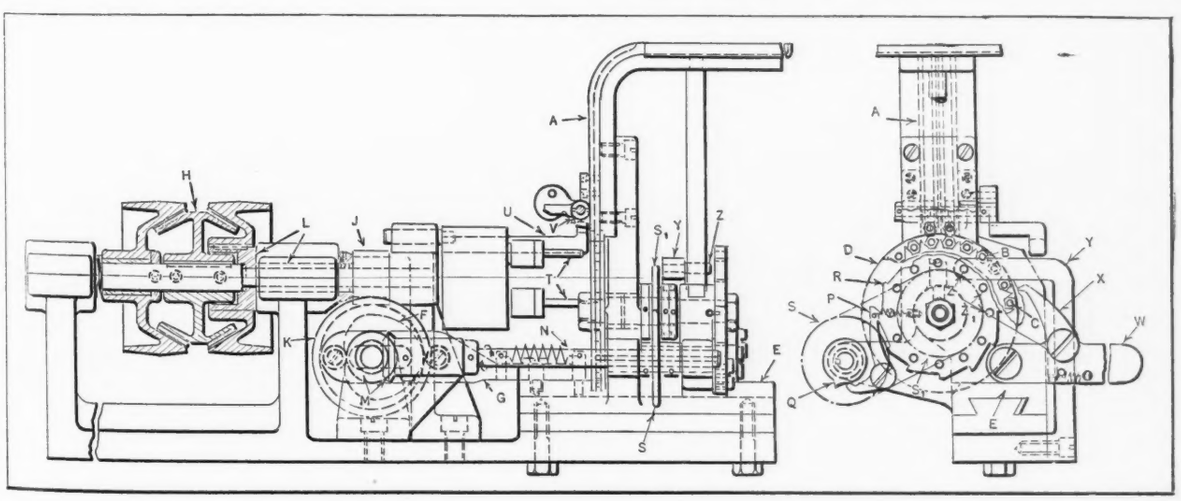
A standard or commercial design of horizontal tapping machine has been converted into an automatic type arranged especially for tapping the No. 10 machine screw nuts which are used extensively by manufacturers of electrical house equipment. This machine has two taps for tapping two nuts simultaneously. The nuts are automatically transferred from the magazine *A* to tapping positions *B* and *C* (see end view of accompanying illustration) by a circular carrier *D*. This carrier, which has twenty-four pockets, is indexed one-twelfth revolution, or the equivalent of two nuts after slide *E* on which the magazine and indexing mechanism are located has withdrawn far enough for the taps to clear the nuts.

The forward and return movements of slide *E* are derived from cam *F*, which engages a roller on connecting link *G*. When slide *E* moves forward and the nuts engage the taps *T*, the main spindle is shifted axially the same as on many other hand-operated tapping machines; consequently, the driving pulley engages the front side of cone *H* and the tapping operation begins. When slide *E* begins its return movement, the main spindle is shifted in the opposite direction; this causes the reversing pulley to be engaged with cone *H* and consequently, backs the taps out of the nuts.

The drive for cam *F* is through worm *J* and worm-wheel *K*, and to insure a continuous drive, the worm is driven by sleeve *L* connecting with the right-hand pulley. This sleeve has teeth on its end which mesh with corresponding teeth on worm *J*.

To obtain the movement for indexing, the camshaft, through miter gears *M* and shaft *N*, rotates sprocket *S*, which connects by chain with the driven sprocket S_1. Fiber disks on each side of sprocket S_1 permit the latter to turn when indexing carrier *D* is locked during the tapping operation by the engagement of pawl *P* with twelve-tooth ratchet *R*. The worm-gear ratio is such that pawl *P* is disengaged by cam *Q* on shaft *N* after slide *E* has withdrawn. Then carrier *D* is indexed by the chain and sprocket drive, but this movement is stopped after one-twelfth revolution, because pawl *P* snaps back and engages the next successive tooth of ratchet *R*.

Before each indexing movement, the two columns of nuts in magazine *A* are raised slightly, so that the nuts at the bottom will clear the carrier. This movement of the nuts is derived from arm *U*, which is fastened to the tapping head. The end of arm *U* engages a projection on the counterweighted lever *V*, which has two fingers that serve as stops for the two columns of nuts. Since the flats on the nuts tend to bear against each other, the bottom nuts will always drop into the dial in the proper position, as indicated by the end view.



Automatic Nut-tapping Machine of Reversing Spindle Type

If jamming should occur, due to defective nuts, chips, etc., the mechanism may be released merely by raising lever *W* far enough to engage pawl *X* with ratchet *R*, thus rotating dial *D* sufficiently to allow the jammed nut to rock back into its seat in the dial. A slight upward blow against lever *W* usually is sufficient.

As any jamming would be likely to change the alignment between the taps and dial holes and cause tap breakage, there is a stationary arm *Y* carrying a pin *Z*, which when the dial is indexing correctly, enters successively holes Z_1 (see end view) spaced equivalent to the indexing movement. If jamming occurs, pin *Z* strikes the inner face of the ratchet wheel, instead of entering a hole, and prevents slide *E* from moving forward, so that the taps cannot come into contact with the dial. Between link *G* and slide *E* there is a flexible spring connection which permits slide *E* to stop advancing when pin *Z* does not engage a hole Z_1. The indexing dial is covered with a guard, not shown, and a small glass window at the top permits the tapping operation to be seen.

* * *

EQUALIZING DEVICE FOR JIGS

By A. W. HARRIS

A recent change in design of a transmission case cover made necessary the design of a drill jig which would equalize the rough casting. Production requirements were such that speed of operation was a requisite second only to accuracy.

The operation consists of drilling four 21/64-inch holes through 3/4-inch bosses, and two 5/8-inch holes to a depth of 1 3/16 inches. It is done in a four-station jig mounted on an index table under an adjustable multiple-spindle drilling machine. Two of the jig stations are in the drilling position while the other two are being loaded. The net production from this equipment during its second month of operation was 115 per hour.

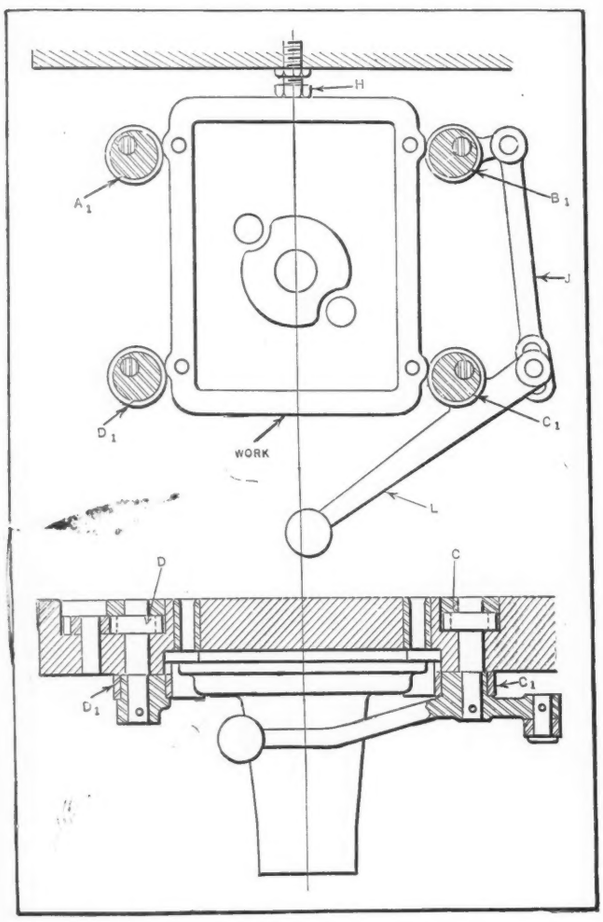


Fig. 1. Equalizing Device for Jigs

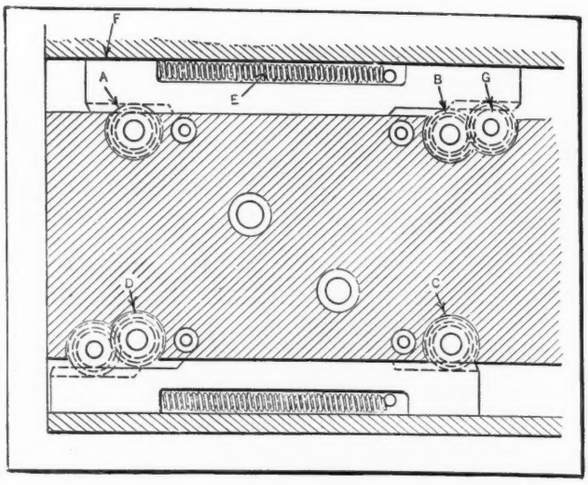


Fig. 2. Horizontal Section through Bushing Plate, Showing Gears and Connecting Racks

The part is clamped against the under side of a bushing plate, by a cam-operated jack, after it is equalized by the device to be described. This facilitates "jigging" by eliminating the necessity for cleaning the locating strips and equalizer. The equalizer is the unusual feature of the jig.

The mechanism of this equalizer is illustrated in Figs. 1 and 2. The four eccentrics A_1, B_1, C_1 and D_1 (Fig. 1) are rigidly attached to the shafts of gears *A*, *B*, *C*, and *D*, respectively. Racks are used to connect the right- and left-hand gears, as shown in Fig. 2, which is a horizontal section through the bushing plate. Spring *E* moves rack *F* to the left, causing gear *A* to rotate in a counter-clockwise direction. Through idler *G* it also causes gear *B* to rotate in a clockwise direction. Eccentrics A_1 and B_1 equalize the work at the rear, and at the same time hold it against stop *H*. A similar mechanism equalizes the work at the front end and assists in holding it against the stop.

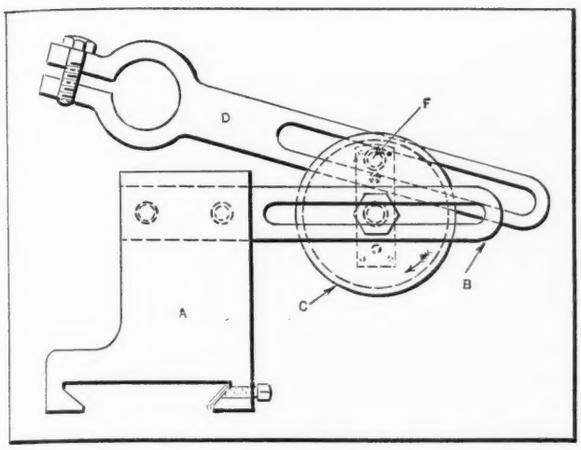
The equalizers are opened by lever *L* on front eccentric C_1. It operates the rear equalizer through a link *J* and a lever arm on eccentric B_1. The pin on lever *L* works in a slot in link *J*, which allows the rear equalizer to travel a lesser or greater distance than the front one if variations in the casting demand it. The additional throw required to move the pin to the end of the slot is obtained by making the arm on eccentric C_1 greater than that on B_1. The eccentrics are equipped with bands or rollers, as shown by the vertical section in Fig. 1.

* * *

PISTON RELIEVING ATTACHMENT

By PAUL F. STEINER

The piston relieving attachment here illustrated is used on a tool and cutter grinder (No. 2 Norton) for relieving automobile engine pistons in the locality of the piston-pin hole. This attachment is



Attachment Used in Grinding Relief Adjacent to Piston-pin Holes

used to give the pistons an oscillating movement while the relief is being ground.

The slotted rocker arm *D* is clamped on the headstock spindle, which receives an oscillating motion as the driving- or crank-pin *F* revolves. This pin engages the slotted arm, and is carried by pulley *C*, which is driven by belt from the countershaft. The pulley may be adjusted along the slotted supporting arm *B* for varying the extent of the oscillating movement. Arm *B* is held by casting *A*, which is clamped to the main table back of the headstock. The piston to be ground is gripped on the inside by a three-jaw chuck. The flanged belt pulley *C* has a diameter of 6 inches and a width of 1 1/2 inches.

* * *

RECIPROCATING MECHANISM OF AIR COMPRESSOR

By C. G. WILLIAMS

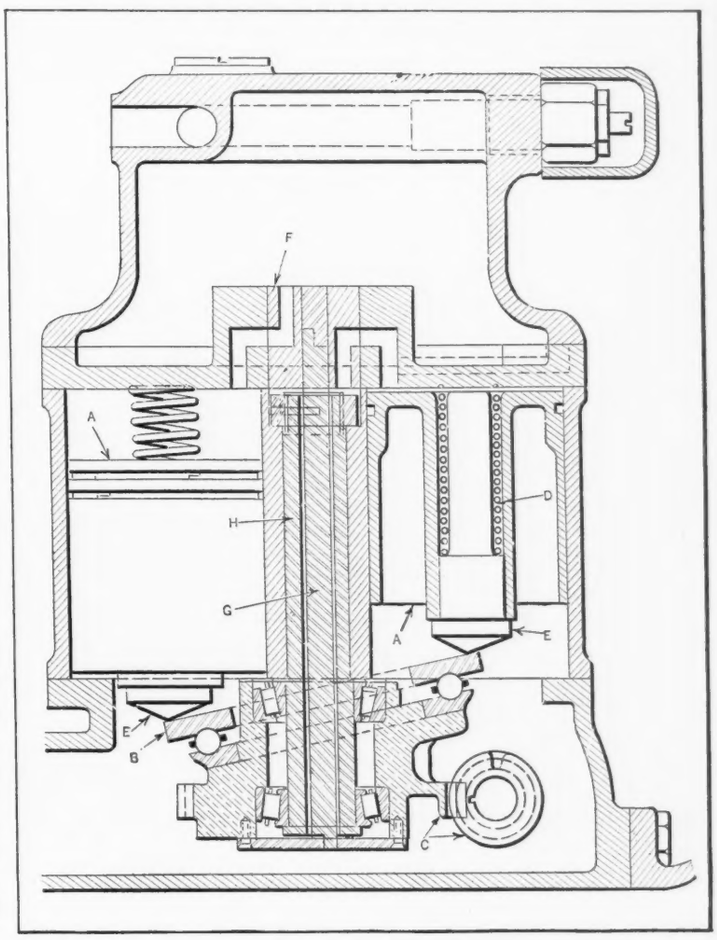
A sectional view of the air compressor of an oil burner is shown in the accompanying illustration. In this equipment, four pistons *A* are reciprocated by a revolving thrust plate *B*, which is located at an angle of 12 degrees. As this plate is revolved by worm-gearing *C*, the pistons will, of course, be forced upward due to the angular location of plate *B*, and the return of each piston is insured by the action of a spring *D* which keeps the hardened steel plug *E* in contact with plate *B*. Every revolution of the worm-wheel causes each of the four pistons to make a forward and return stroke. This worm-wheel revolves on Timken roller bearings, and the thrust plate is supported on a ball bearing. The rotary valve *F*, which opens and closes the air ports, is driven from the worm-wheel by a connecting shaft *G*.

In the illustration, the right-hand piston has delivered its quota of air and is ready for the downward stroke, the valve being timed to allow air to be drawn through shaft *H* as the piston descends. The valve, as shown, has connected the compressed air reservoir with the left-hand cylinder, although actually the port does not open until the piston has completed nearly three-fifths of its stroke, thus preventing, as far as possible, a pulsating action of the air due to the small capacity or space above valve *F*. The four cylinders, each of which is 3 inches in diameter, are so located that their center lines form a 3 1/4-inch square.

In this oil burner, the oil is atomized by the use of compressed air generated by this mechanism, and a surplus of low velocity air for complete combustion of the fuel is furnished by a fan, not shown. The worm-gearing is continually submerged in oil to half its depth, and the splash from the worm lubricates the Timken bearings and the pistons. The oil spray, carried along by the air being compressed, is sufficient to lubricate the rotary valve. A relief valve in the cover above valve *F* allows any surplus air not needed for atomizing the oil to be returned to the intake side so that it can be compressed again. This mechanism was originated by G. D. Sunstrand.

* * *

The high-powered airplane-carrier *Lexington* of the United States Navy was referred to in August MACHINERY, page 944. The *Lexington* is supplied with engines generating 180,000 horsepower. If this power were used for other purposes than to drive the ship, it would, for example, produce sufficient electricity to take care of all the light, heat, and power requirements of a city of, say, the size of Boston.



Reciprocating Mechanism of Air Compressor for an Oil Burner

Machine-building Costs Reduced by the Oxy-acetylene Cutting Process

PIONEERS in the construction of machinery from rolled steel were handicapped by the lack of equipment for economically cutting the plates and sections. Hence, manufacturers had to either use light plates which could be sheared in machines, or cut heavy plates by drilling holes close to each other along the desired outlines. It was necessary to shape or plane the drilled edges of the heavy plates in order to give them a satisfactory appearance. This was the condition when the Dreis & Krump Mfg. Co., 74th and Loomis Sts., Chicago, Ill., was organized thirty-one years ago for building sheet- and plate-bending machines of rolled steel construction. Machines of this construction were costly, and though lighter in weight and stronger than machines made of wood and cast iron, they were hard to sell.

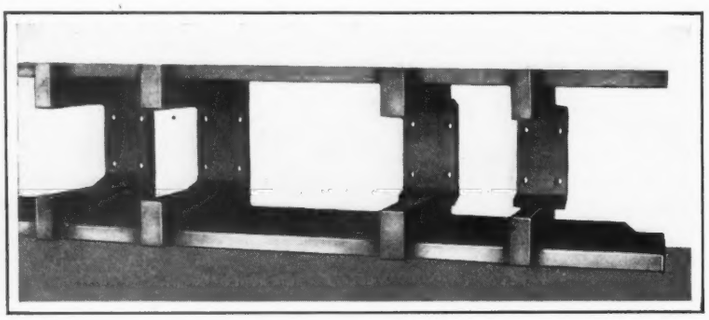


Fig. 1. Heavy Machine Part Constructed of Steel Plates Cut by the Oxy-acetylene Process and Welded Together

With the development of the oxy-acetylene cutting process, however, the handicap in fabricating heavy steel plates on an economical basis was removed. The company mentioned now builds machines from steel plates up to 8 inches thick, 6 feet wide, and 16 feet long. Main housings are constructed of one plate, round holes being cut with the oxy-acetylene torch to receive boxes for shaft bearings, which are welded in place. A semicircle to form the gap is also cut in each housing by means of a torch. Rams and beds are made of one plate, cut to the desired outline. Gears are made by rolling a bar of steel to form the rim, cutting a circular plate to form the web, welding these two parts together, and welding a piece of tubing on each side of the web to form a hub. Gears from 12 inches to 10 feet in diameter, with faces as wide as 8 inches, are made in this manner. The electric welding process is used exclusively.

Fig. 1 shows a frame part weighing 9100 pounds, which was produced by cutting out various plates to the desired outline and welding them together. With this method of building machines, patterns are eliminated and there are no blow-holes or similar defects, such as are frequently found in castings. The oxy-acetylene cutting process has not only permitted the production of cheaper machines of rolled steel construction, but has also enabled larger machines to be built than would be feasible without the process. Machines developing a pressure of from 50 to 500 tons have been constructed by the Dreis & Krump Mfg. Co.

Most plates are cut by employing either a straight-line cutting machine or a circular cutting machine which is adjustable to any diameter from 3 to 24 inches. The straight-line machine is illustrated in Fig. 2. It consists of a long bed, adjustable for height, on which is mounted a carriage having a cross-slide, which carries the cutting torch. The torch can be fed lengthwise by turning a handwheel at either end of the bed, which actuates the carriage through a lead-screw, and it can be fed transversely by turning a handwheel at the front of the cross-slide. The machine is mounted on a light piece of steel plate, and the entire unit is set on the plate to be cut. By manipulating the handwheels, the cutting torch can be made to follow both curved and straight outlines previously scribed on the plates to be cut. Plate edges cut by this process are smooth and require no machining.

* * *

A prediction made years ago by de Lesseps, the builder of the Suez Canal, that the Panama Canal would some day outstrip the Suez Canal in tonnage handled, has come true. In 1926, vessels with a gross tonnage of 26,836,000 tons paid tolls for using the Panama route, while the traffic through the Suez Canal during the same period aggregated 26,606,000 tons.

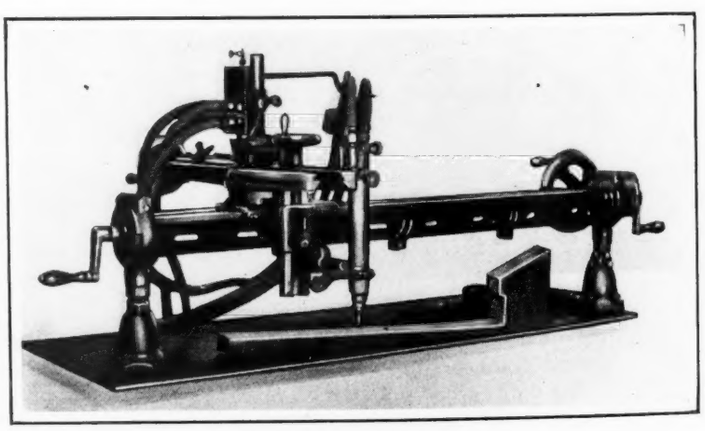
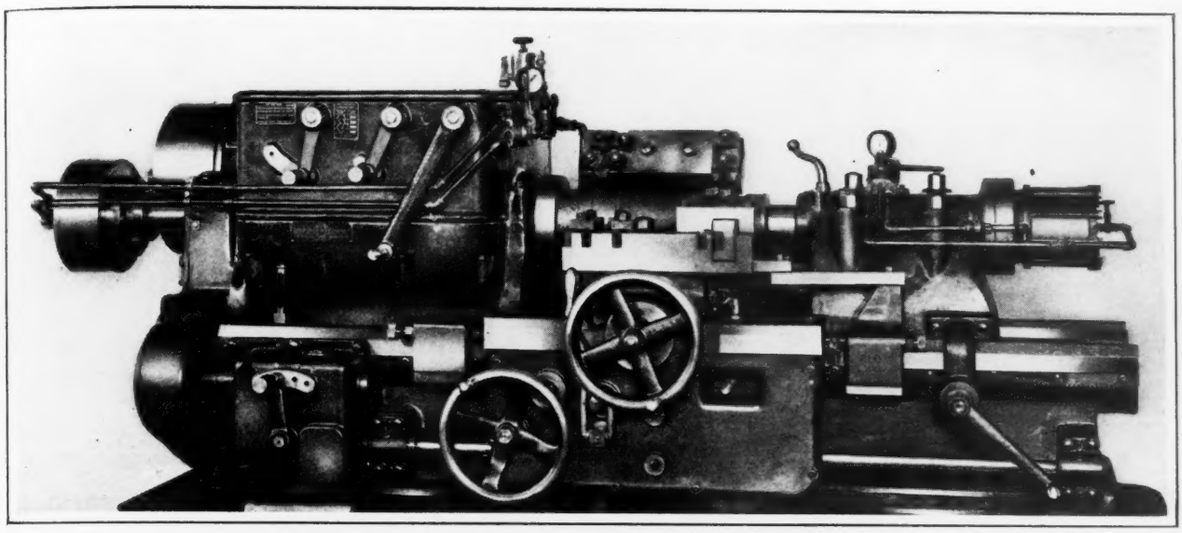


Fig. 2. Oxy-acetylene Machine Employed in Cutting Steel Plates to Various Outlines



Air Chuck Designs

Time- and Effort-saving Pneumatic Equipment Applied to Machine Tools

By CHARLES O. HERB

ONE of the principal factors controlling the output of a machine tool is the time required for reloading the work. Sometimes the reloading time is greater than the actual cutting time. Hence, if maximum production is to be obtained from a machine, it must be provided with chucking equipment that will permit rapid loading and unloading of the work. Examples of pneumatic equipment built by the Logansport Machine Co., Logansport, Ind., with a view to reducing the loading time of machines to a minimum and eliminating manual effort as far as possible, will be described in this article.

An advantage pointed out by manufacturers of air chucks is their instantaneous operation through a valve, which may be operated by hand, by foot, or automatically. When the valve is operated by foot or automatically, both hands of the operator are free for removing and loading work. Certain parts can be chucked or unloaded while the machine is in operation. Parts can also be gripped with any desired force by merely adjusting the air pressure through a regulating valve. With such an arrangement, it is possible to exert any desired clamping pressure on the work within the capacity of the equipment. Uniform distribution of the clamping pressure is claimed to lessen the likelihood of distorting the work.

Air-operated Chuck and Tailstock on Lathe Designed for Quantity Production

A Reed & Prentice No. 2 "Production" lathe equipped with an air-operated chuck and tailstock to expedite the machining of cast-iron sleeves is shown in the heading illustration. These sleeves are approximately 13 3/4 inches long, 6 inches maximum external diameter, and 4 3/4 inches minimum internal diameter. As may be seen at *A* in Fig. 1, the headstock spindle of this lathe is equipped with a "Logan" 10-inch double-acting

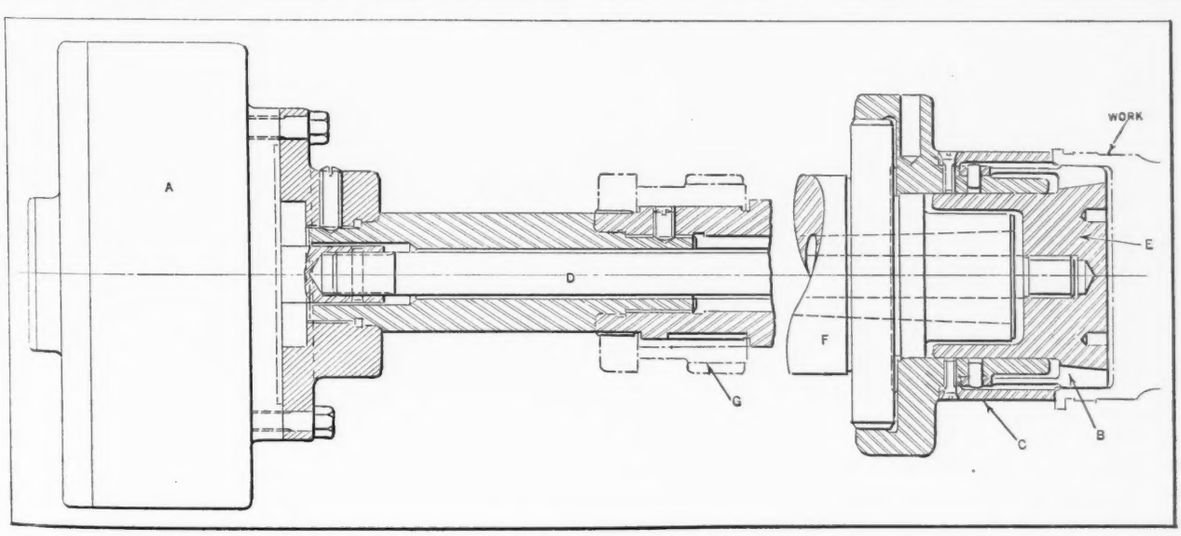


Fig. 1. Air-operated Expanding Arbor Provided on the Headstock of the Lathe Shown in the Heading Illustration

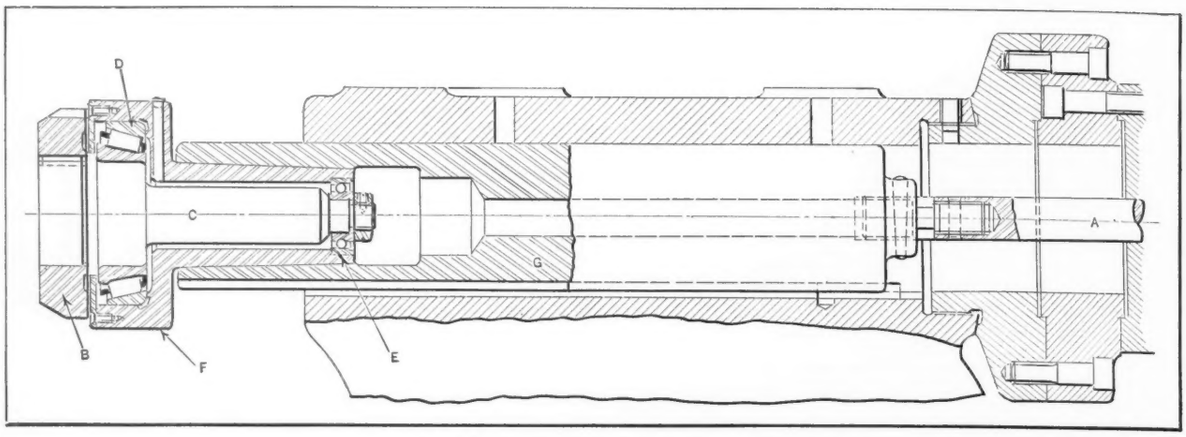


Fig. 2. Pneumatic Equipment Provided in the Tailstock of the Machine Shown in the Heading Illustration, which Facilitates the Loading and Removing of Work

cylinder, which rotates with the spindle. Air is admitted into the cylinder on either side of the piston by operating a valve seen on the right-hand end of the headstock in the heading illustration.

In loading this machine, a finished counterbore in one end of the sleeve is seated over the split collet *B*, Fig. 1, until the finished face of the sleeve comes in contact with the front face of nose ring *C*. Then the valve on the headstock is operated to admit air into cylinder *A* on the front side of the piston, which pulls rod *D* toward the left, this rod being connected to the piston-rod. Rod *D* is screwed into expander *E* and pulls this part toward the left with it, so as to expand the split collet *B* against the counterbore of the work. Air pressure is maintained on the front side of the piston during the operation, and when it has been completed, the valve on the headstock is moved a second time to admit air into the cylinder on the back side of the piston, at the same time allowing the air on the front side to escape. This causes the chuck mechanism to function in the reverse manner, thus releasing the work. Gear *G* drives spindle *F*, which, in turn, drives the work.

At the same time as the headstock air valve is operated to effect the gripping of the work on the left-hand end, a valve mounted on top of the tailstock, as shown in the heading illustration, is turned to admit air into the back end of a 6-inch double-acting non-rotating cylinder mounted on the tailstock. Piston-rod *A*, Fig. 2, of this cylinder, is then moved forward to advance plug *B* into the right-hand end of the work so as to support this end adequately during the operation. Plug *B* is mounted on the front end of a shaft *C*, which is supported by the tapered roller bearing *D* and the radial ball bearing *E*. These bearings are contained in holder *F*, which is a tight fit in bar *G*. The latter is connected to piston-rod *A*, and is moved backward and forward by it.

Upon the completion of the operation, when the headstock valve is operated to release the left-hand end of the work, the tailstock valve is also operated to admit air into the tailstock cylinder on the front side of the piston, thus pulling plug *B* toward the right. As the tailstock piston has a stroke of 3 inches, plug *B* does not interfere with the reloading of work. The time involved in unloading a finished piece of work and loading a new piece into this machine, is approximately 20 seconds.

Pneumatic Chuck Expedites a Grinding Operation

The grinding of small crankshafts for washing machines in the Cincinnati grinding machine illustrated in Fig. 3 is facilitated by the provision of the air chucking equipment shown in Fig. 7. The chuck is opened and closed on work *A* by the action of a rotating air cylinder, which is mounted directly on the left-hand end of the machine spindle *C*. In loading the chuck, the long shaft extension of the

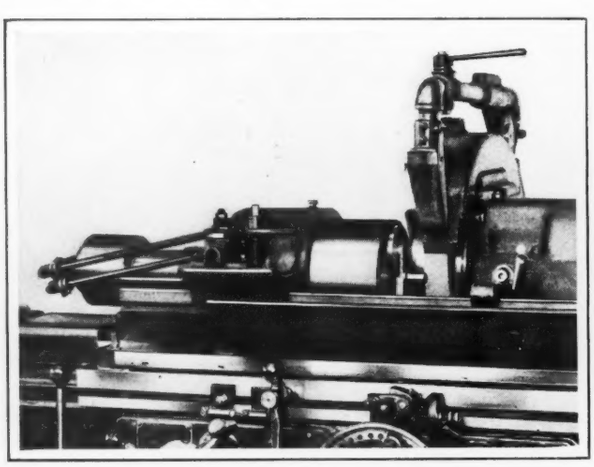


Fig. 3. Grinding Machine Equipped with an Air-operated Collet Chuck of Special Design

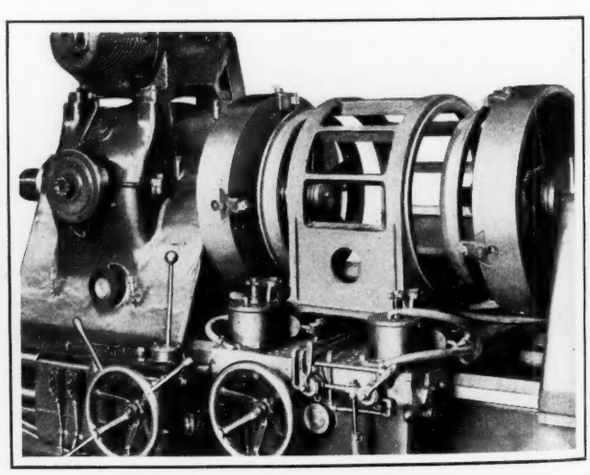


Fig. 4. Method of Clamping a Motor Housing to a Lathe Carriage with Four Air-operated Units

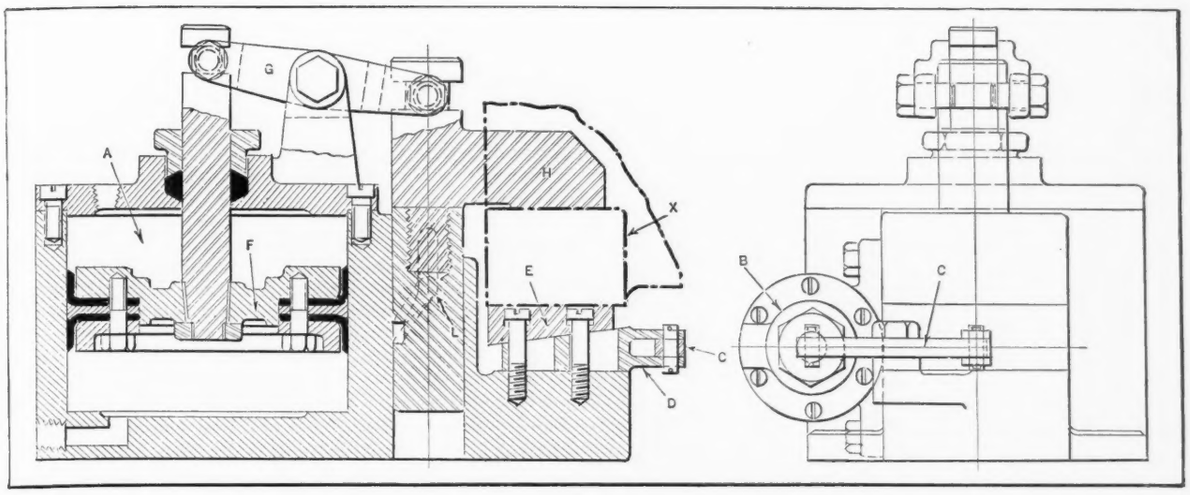


Fig. 5. Construction of the Special Clamping Fixture Illustrated in Fig. 6

crankshaft *A* is inserted into split collet *D*, with the end of the crank arm in the vee of a hinged yoke *E*. This yoke serves to so locate the crank arm that the portion of the work to be ground is in line with the center of the machine spindle. Lengthwise location of the work is obtained by seating a previously finished shoulder on the crank arm against the hardened and ground plate *F*.

After the work has been placed in the chuck as described, air is admitted into the cylinder in front of the piston so as to pull the piston and its rod toward the left. Shaft *G*, to which the piston-rod is connected, is also pulled backward, causing plate *L* and part *H* to move with it. Part *H* actuates the collet unit, causing the split tapered sleeve *J* to be compressed as it is pulled along the tapered hole in housing *K*. The compression of sleeve *J* exerts a pressure on split collet *D* sufficient to grip the work securely for the operation. Part *H* is screwed into a tapped hole in plate *L*.

At the end of an operation, air is admitted into the cylinder in back of the piston to force the moving parts of the chuck forward and release the work. Hardened and ground plug *M*, which is screwed into a tapped hole in plate *L*, engages a hole in housing *K* to pilot plate *L* in its movements to and fro when opening or closing the collet. The cylinder provided for this equipment allows a piston stroke of 1 inch. Reloading of work in this machine requires about 7 seconds.

Clamping Units for a Lathe Faceplate

Four clamping fixtures, such as shown in Fig. 6, are mounted on the carriage of a large lathe, as illustrated in Fig. 4, for holding the housings of 75-horsepower motors. The lathe has two direct motor-driven headstocks at opposite ends of the bed, which permit of machining both ends of the housings simultaneously. Each of the clamping units grips one of the feet of the housings, and the arrangement is such that the feet are gripped without distortion. However, the main advantage obtained with the installation is the small amount of time required for chucking and removing the work.

The motor housings are accurately located for the operation by entering two large bell centers into the housing ends. These bell centers are mounted on the two headstocks. Each clamping unit has two cylinders located at *A* and *B*, Fig. 6. Cylinder *A* has a bore of 6 inches and a stroke of 2 1/4 inches, while cylinder *B* has a 2-inch bore and a 5/8-inch stroke.

After a motor housing has been placed in the lathe with each foot on one of the clamping units, as indicated by the dot-and-dash lines *X*, Fig. 5, air is first admitted into the small cylinder *B* of all four units. As the piston of this cylinder moves forward, it swivels link *C* and causes it to push wedge *D* under block *E*. This results in block *E* being raised tightly against the foot of the motor housing.

Air is then admitted into cylinder *A* of all four units to force piston *F* upward and cause it to swivel link *G*. This link, in turn, exerts pressure on clamp *H*, pushing the clamp down firmly on top of the motor housing foot. When clamp *H* is in the raised position, the clamping arm swings out of the way, as may be seen in the right-hand view of Fig. 6. However, when link *G* pushes downward

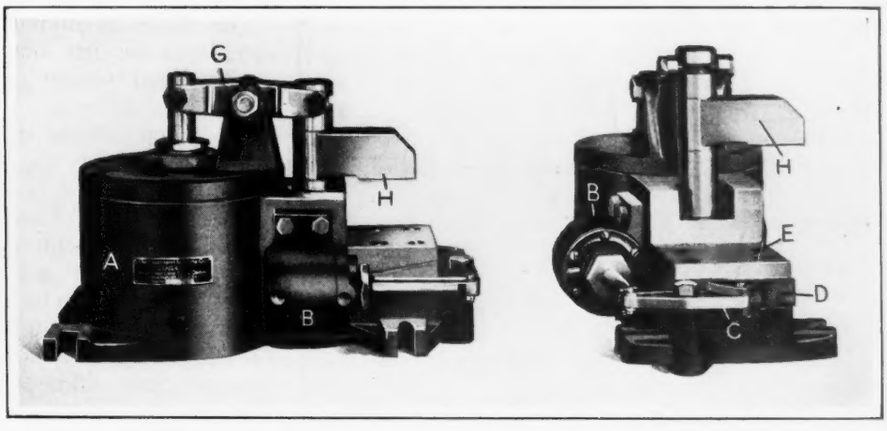


Fig. 6. Special Clamping Unit Designed for Holding Motor Housings to the Faceplate of a Lathe

on the clamp, the latter is turned 90 degrees on the axis of its stem through the action of a pin *L*, Fig. 5, fastened in the fixture housing, which engages a bayonet groove in the clamp stem. This swiveling feature of the clamps provides for convenient loading and unloading of the motor housings, since it obviates interference of the clamps with the housing feet.

By providing clamping units with individual cylinders for this lathe operation, the motor housings are gripped firmly on all four feet, because the cylinders automatically compensate for any irregularities in the thickness of the feet. The over-all height of the clamping units when piston *F* is in its extreme raised position is 10 inches, while the over-all length is 14 3/4, and the over-all width 8 3/8 inches.

Drilling Machine Jig Operated by Air

The pneumatic equipment illustrated in Fig. 8 is employed in countersinking two holes in shackle plates, such as seen at *A*, which are approximately 3 inches square by 1/2 inch thick. For this operation, each shackle plate is positioned on the hinged part *B*, which is positioned at the front of the fixture as indicated by the dotted lines *X* when the loading is being performed. The drilled holes in the shackle plate, which are to be countersunk in the operation, are seated over two spring-actuated plungers *C* and two locating pins *D*, all four of which are fastened to part *B*.

With the work piece on part *B*, air is admitted into cylinder *E* on the left-hand side of the piston, so as to move the piston and the lower wedge-block *F* toward the right. Upper wedge-block *G* is moved with block *F* until it strikes stop-screw *H*. Then as block *F* is pulled still farther to the right, block *G* rises vertically until the upper side of work *A* is seated firmly against four buttons *J*. When the countersinking tools enter the work through bushings in plate *K* of the fixture, they force the spring plungers *C* downward out of the way.

At the end of the operation, air is admitted into cylinder *E* on the rear side of the piston to push it

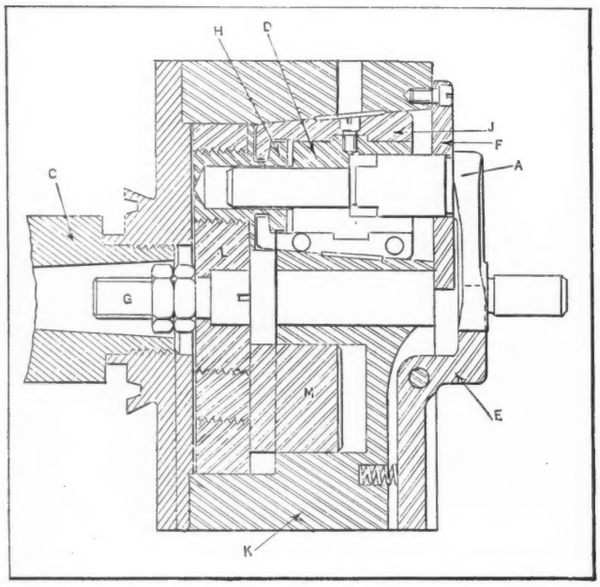


Fig. 7. Construction of the Chuck with which the Machine Shown in Fig. 3 is Equipped

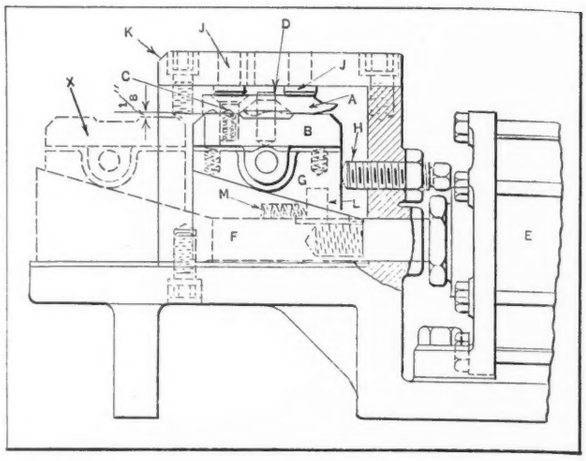


Fig. 8. Drill Jig Operated Pneumatically to Permit Rapid Loading and Unloading of Work

and block *F* forward for releasing the work. Block *G* remains stationary until a ledge on block *F* strikes pin *L*, which is fastened to block *G*. The entire work-supporting unit then moves forward to the loading position indicated by the dotted lines. Spring *M* causes block *G* to move downward on block *F* before the latter can push it to the left. Cylinder *E* has a bore of 4 1/2 inches and a stroke of 3 1/2 inches.

* * *

KEEP MANUFACTURING PLANTS CLEAN

By A. H. VOGEL

In order to keep the shop clean, one manufacturing plant instituted the following procedure: At a regular foremen's meeting the subject was discussed, and the foremen adopted the rules given below:

1. Foreman to appoint an employe to gather up scrap twice a day.
2. Foreman to go to each person in his department and insist that the vicinity of his work place or machine be kept clean and in an orderly condition.
3. Watchmen to be instructed to see that employes eating their lunches in the shop clean up afterward; if not, report.
4. Men working in various departments throughout the shop to clean up when through (millwrights, pipe fitters, repair men, etc.).
5. Prevent spilling oil or coolant on the floor.
6. Censure offenders or penalize, in a mild way, employes for not keeping premises clean.
7. Keep plenty of sawdust on hand for oily floors.
8. Stop passing the buck. Every foreman must be sure that his department is kept in first-class condition.
9. Make use of an educational poster campaign.
10. Hang a pennant in the cleanest department for two weeks at a time, the winning department to be decided upon by a committee. (The plant manager personally bought the pennant.)

These suggestions were adopted by the plant management. The employes now take pride in keeping the various departments clean. This has been accomplished without additional cost and there is considerable competition for the pennant.

Electric Drives for Machine Tools

By GORDON FOX, Electrical Engineer and ARTHUR J. WHITCOMB, Assistant Electrical Engineer, Freyn Engineering Co., Chicago, Ill.

IN June MACHINERY, the general requirements of electric motor drives for machine tools were dealt with in an article beginning on page 767. In July MACHINERY, motor drives for lathes, boring mills, and milling machines were covered in an article beginning on page 831. In August MACHINERY, the subject of motor drives for shapers, planers, and slotters was discussed in an article beginning on page 909. The present article, which is the last in the series, will discuss the application of motor drives to drilling machines, grinding machines, presses, and punches and shears.

Motor Drives for Drilling Machines

Sensitive drilling machines are usually equipped with cone pulleys or a gear-box providing all necessary speeds, so that constant-speed motors with the simplest form of manual control are satisfactory. Not infrequently small drilling machines are group-driven. In some instances, vertical motors are direct-connected.

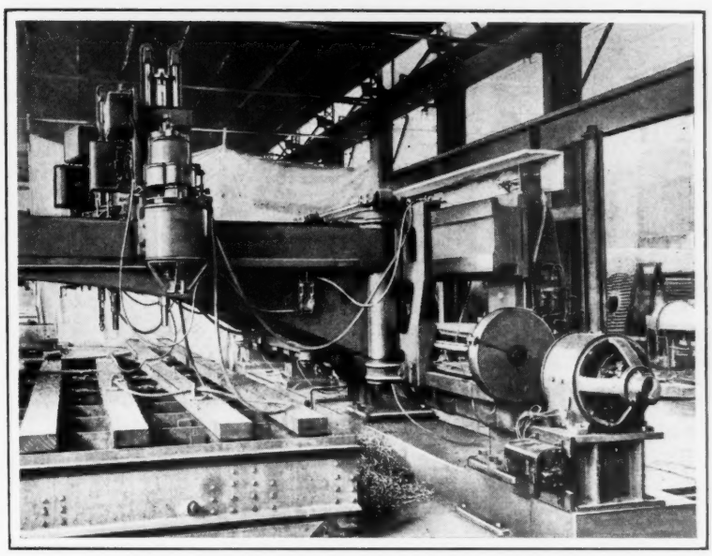


Fig. 1. Boiler Plate Radial Drilling Machine Driven by Three 7 1/2 Horsepower Variable-speed Motors and One 10 Horsepower Constant-speed Motor

The heavier duty drilling machines of both the radial and vertical types fall into two classes, one in which the spindle is reversed by friction clutches that engage reversing gears, and the other in which the spindle is reversed by reversing the motor. In the first class, almost any type of equipment may be used. When only alternating current is available, a squirrel-cage motor and a manually operated starter may be employed. In cases where direct-current is available, adjustable-speed motors are usually installed to obtain as many speed changes as possible. When upright drilling machines are used for several operations, drilling to a jig, the adjustable-speed motor may prove distinctly advantageous.

For the larger upright drilling machines and for radial drills, adjustable-speed motors are commonly warranted. The control is usually non-reversing. When the spindle is to be reversed by reversing the motor, a reversing type of drum controller may be used with an adjustable-speed direct-current motor. In case it is necessary to use an alternating current, a wound-rotor induction motor should be employed, in order to have sufficient torque to start or back out a tap which is embedded in the work. With this equipment, a drum or semi-automatic control may be used.

The vertical-shaft motor has been applied for driving the spindle of radial drilling machines. This type of drive minimizes the amount of transmission gearing, and is highly efficient. A second motor, mounted on the column, is provided for raising and lowering the arm, and for sliding the drilling spindle on the arm. There may be objection to mounting the motor on the saddle because of the vibration caused by rotation of the motor, or its weight when the saddle is at the end of the arm. A drive that avoids this disadvantage utilizes a horizontal motor mounted on the extension arm on the opposite side of the column, thus relieving the arm of the motor weight. The motions are transmitted through a horizontal grooved shaft running the length of the arm. The same motor is used for raising and lowering the arm.

On a radial drilling machine, the column swings with respect to the base, and a small reversing motor is provided for operating the clamping device, locking the two together while operating the machine. This motor should be provided with a jam resistor or should be designed so that it can remain stalled with power on it for a reasonable length of time. Series-wound alternating-current or direct-current motors may be used for this service. The alternating-current motors should have the compensating field shunted by an external resistor to reduce the no load speed, which may cause the armature to store up sufficient kinetic energy to lock the clamp so tight that the motor will be unable to unlock it.

Motor sizes for standard types of drilling machines are listed in Table 1.

Motor Drives for Grinding Machines

For pedestal grinders, constant-speed motors such as the shunt-wound, direct-current, and squirrel-cage alternating-current types are commonly used. These are totally enclosed, equipped with ball or roller bearings, and provided with double extended shafts to receive the grinding

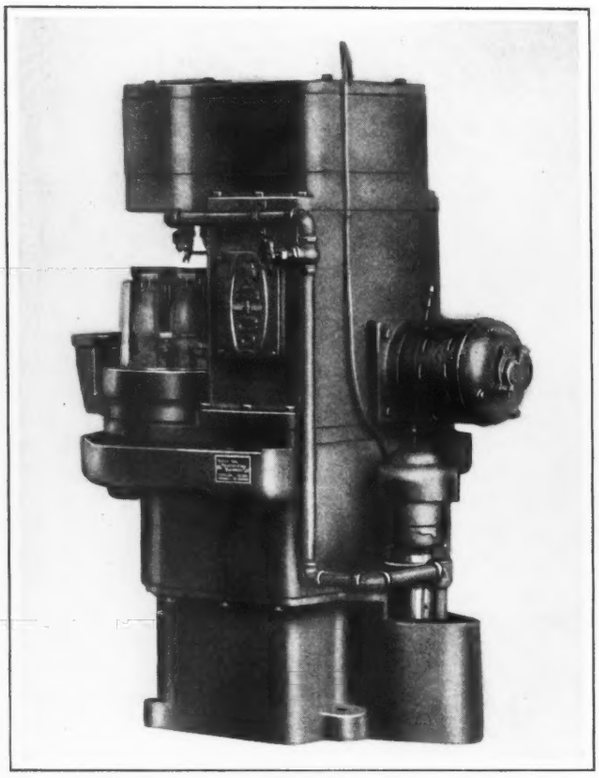


Fig. 2. Interesting Method of Attaching Motor to a Drilling Machine

wheels, which are overhung. Sometimes the motor is located in the base of the grinder, and belted to the grinder shaft. A simple manual starter is all that is required for controlling this form of grinder. Cylindrical grinders are driven by constant-speed motors with gear changes to give the desired adjustment of grinding wheel speed. A simple manual starter is all that is required in this case also.

The use of adjustable-speed direct-current motors enables the most advantageous wheel speed to be maintained. Some general-purpose grinders are provided with a field rheostat located in the base of the machine and connected with the tool-rest in such a manner that the rheostat arm is moved when the tool-rest is moved inward as the wheel wears. In this way, a constant grinding speed is maintained, independent of the wheel diameter.

The proper peripheral speed for grinding wheels is about 5000 to 7000 feet per minute, depending upon the type of wheel, the material ground, and the finish desired. In grinding soft steel with soft, free-cutting wheels, a lower speed should be used for finishing than for roughing. When harder and more compact wheels are used, a higher finishing speed may be employed. If a grinding wheel becomes glazed, the wheel is too hard for the work or the speed is too high. If the wheel becomes loaded or clogged with the material being ground, the bond in the wheel may be too hard or the wheel speed may be too low.

Some forms of cylindrical grinders have an additional motor mounted on them for rotating the work. These motors should be of the adjustable-speed, direct-current type. When direct current is not available, a small generator is mechanically connected to the main driving motor to supply direct current for the smaller motors.

The load demand of a grinding wheel is subject to wide variation, dependent upon many factors. The feeding pressure affects the load decidedly. Because the load is not definite and is subject to peaks, motors for grinder service should have high

Table 1. Motors for Drilling Machines

Upright Drilling Machines	
Size of Machine, Inches	Horsepower of Motor
12 to 20	1
24 to 28	2
30 to 32	3
36 to 40	5
50 to 60	5 to 7 1/2

Multiple-spindle Drilling Machines		
Size of Drills, Inches	Maximum Number of Spindles	Horsepower of Motor
1/32 to 1/4	6 to 10	3
1/16 to 3/8	10	5
3/16 to 1/2	10	7 1/2
1/4 to 3/4	10	10
3/8 to 1	10	10 to 15
2	4	7 1/2
2	6	10
2	8	15

Radial Drilling Machines		
Size of Arm, Feet	Horsepower of Motor	
	Average Service	Heavy Duty
3	1 to 2	3
4	3	5
5	7 1/2	10
6 to 7	7 1/2	10 to 15

Machinery

Table 2. Motors for Punches

Diameter of Hole, Inches	Thickness of Plate, Inches	Horsepower of Motor
3/8	1/4	1
1/2 to 5/8	1/2 to 5/8	2 to 3
3/4	3/4	3 to 5
7/8 to 1	1/2 to 3/4	5
1 to 1 1/4	1	7 1/2 to 10
1 3/4 to 2	1	10 to 15
2 1/2	1 1/2	15 to 25

Machinery

Table 3. Motors for Shears

Width of Work, Inches	Horsepower Required to Cut 1/8-inch Iron	Horsepower Required to Cut 1/4-inch Iron
30 to 42	3	5
50 to 60	4	7 1/2
72 to 96	5	10

Machinery

Table 4. Motors for Plate Shears

Size of Plate, Inches	Length of Stroke, Inches	Cuts per Minute	Horsepower of Motor
3/8 x 24	3	35	10
1 x 24	3	20	15
2 x 14	4 1/4	15	30
1 x 42	4	20	20
1 1/2 x 42	4 1/2	15	60
1 1/4 x 54	6	18	75
1 1/2 x 72	5 1/2	20	10
1 1/4 x 100	7 1/2	10 to 12	75

Machinery

pull-out torque and liberal motoring is desirable, particularly for the smaller sizes where overloads may be more easily imposed. Grinders are built in such variety that it is not feasible to list the motor sizes. The ordinary range of sizes is from 3 to 15 horsepower, although larger grinders and special types are being developed, using motors up to 50 horsepower.

Presses, Punches, Shears, and Bulldozers

Machines of this class require high torques for short intervals. Flywheels are commonly provided to assist the motor in carrying the peaks. However, the flywheel is of value only when it has time

Table 5. Motors for Lever Shears

Size of Work, Inches	Horsepower of Motor
1 by 1	5
1 1/2 by 1 1/2	7 1/2
2 by 2 and 6 by 1	10
2 1/2 by 2 1/2	15
2 3/4 by 2 3/4 and 1 by 7	20
3 1/2 by 3 1/2 and 4 1/2 round	30

Machinery

Table 6. Motors for Bulldozers or Forming and Bending Machines

Width of Work, Inches	Head Movement, Inches	Horsepower of Motor
29	14	5
34	16	7 1/2
39	16	10
45	18	15
63	20	20

Machinery

Table 7. Motors for Bending and Straightening Rolls

Width of Rolls, Feet	Thickness of Metal, Inches	Horsepower of Motor
4 to 6	3/8 to 5/16	5
6	7/16	7 1/2
6	3/4	15
8	7/8	25
10	1 1/8	35
10	1 1/2	50
24	1	50

Machinery

to come up to speed before the next operation. For high-speed presses, there is a limiting point at which it is good practice to discard the flywheel and permit the peak load to be absorbed directly by the motor.

However, for ordinary work, the flywheel will be found desirable. The motor must have a drooping speed characteristic, in order to utilize the kinetic energy in the flywheel. A direct-current compound-wound motor should have sufficient series field to give 15 to 20 per cent slow down under full load. A shunt-wound motor fails to utilize the flywheel sufficiently and is, therefore, subjected to severe torque peaks. Moreover, a shunt motor is likely to give trouble when driving a load having high inertia, in case of voltage fluctuations.

Induction motors are particularly suitable for driving machines of this type. In the smaller sizes, squirrel-cage motors with high resistance type rotors are well adapted. For medium and large machines, the wound-rotor induction motor is the rational choice. Fixed resistance sufficient to give

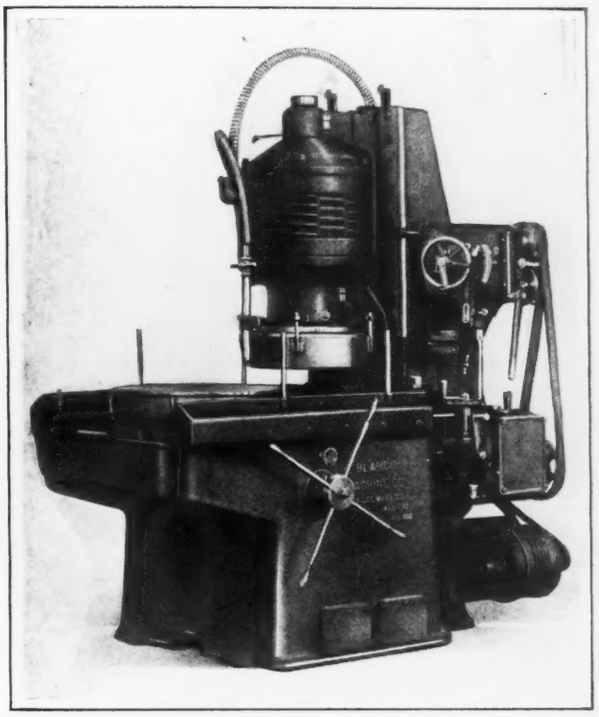


Fig. 3. Twenty Horsepower Vertical Squirrel-cage Induction Motor Driving the Wheel and a 3 Horsepower Squirrel-cage Induction Motor Driving the Table and Pump of a Surface Grinding Machine

15 to 20 per cent slow down under full load should be connected in the secondary circuit of the motor. Because of the high inertia of machines of this type, the motors should have high starting torque

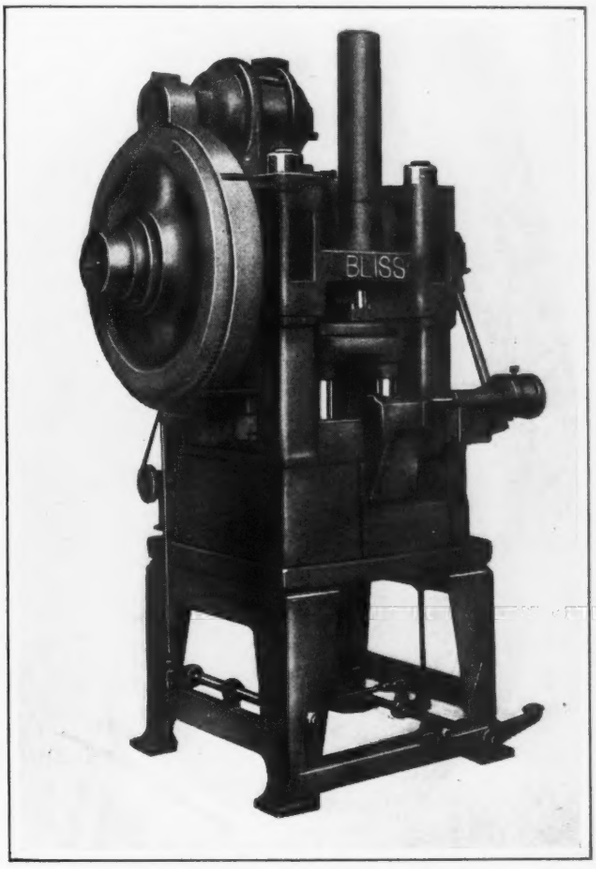


Fig. 4. A Squirrel-cage Induction Motor Driving a Combination Punch and Shear

and should be accelerated slowly. Non-reversing control is commonly employed. Sometimes a reversible or plugging control is used, in order to supply a means for stopping the flywheel quickly. In cases where plugging control is used, the rotor winding of an induction motor must be suitably insulated.

Punch presses and shears frequently have a belt drive between the motor and the machine. This belt is used for the purpose of cushioning the shock on the motor caused by the punch hitting the work. Machines provided with flywheels are not protected

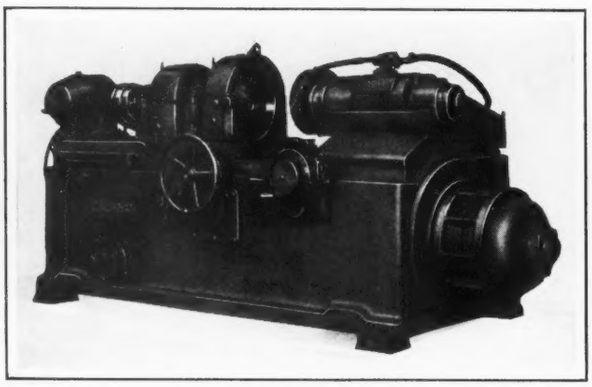


Fig. 5. Grinding Machine in which the Wheel is Driven by a 30 H.P. Squirrel-cage Motor and the Work-carrying Headstock by a 2 H.P. Adjustable-speed Motor

mechanically by the overload devices in the motor control, as the kinetic energy that is stored up in the flywheel is ordinarily sufficient to damage the machine.

Shears have been built without flywheels and equipped with motors having a series characteristic. The motor starts and stops for each stroke. During the cut, the motor slows down and develops a high torque. This type of equipment is said to have a number of advantages, namely, elimination of a clutch; better controllability; protection against damage by stored energy in the flywheel; and elimination of idling losses.

Such a large variety of machines fall within the general classification of presses, punches, and shears that anything approaching a complete tabulation of motor sizes cannot be made. Motor sizes recommended for a few of the more common machines are given in Tables 2 to 6, inclusive.

Bending and Straightening Rolls

Machines of this type are, in general, subject to frequent starting, stopping, and reversing. This service calls for the use of heavily compounded direct-current motors or wound-rotor induction motors. Drum type controllers are suitable for the smaller machines, but magnetic control is preferable when the larger motors are used. Table 7 gives motor sizes listed for standard bending and straightening rolls.

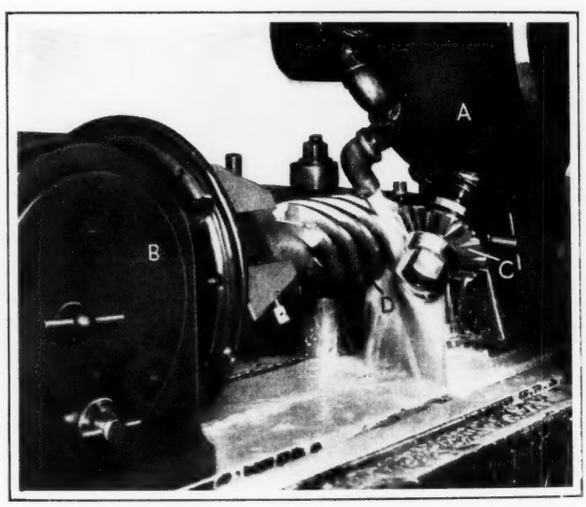
The machines discussed in the foregoing represent but a small portion of the machine tool field. In these days of quantity production, a great variety of special machines have been devised to meet special requirements. However, the same general principles apply both to standard and to special machines.

MILLING WORM TEETH

By HOWARD ROWLAND

In the accompanying illustration is shown a milling machine equipped with a universal spiral milling attachment *A* and a universal indexing and dividing head *B*. These two attachments make it possible to mill the worm teeth as shown. The spiral attachment is set to the helix angle of the teeth, and the correct lead is obtained by the use of a combination of gears on the driving mechanism of the dividing head. The spacing of the teeth is obtained by employing the dividing head in the usual manner. The size and the angle of the teeth are determined by the special 4 1/2-inch diameter form cutter *C*. The material from which the worm *D* is milled is S.A.E. 3145 steel.

Two cuts are required to complete the worm. For the first or roughing cut, the operator places the work between centers, using a dog on the end next to the driving head. The table is then adjusted to give a cut 0.700 inch deep, and the power longitudinal feed engaged. At the end of the cut the table is moved so that the cutter clears the work, after which it is returned at a fast rate of feed. The dividing head is then indexed and the cycle of operations repeated for the remaining teeth. A table feed of 2 inches per minute, equal to a movement of 3.4 inches per minute for the



Milling Worm Teeth

work past the cutter, and a cutting speed of 75 feet per minute, are employed.

The same procedure is followed in taking the finishing cut except that a cutting speed of 116 feet per minute is used. Approximately 0.030 inch of stock is removed at the finishing cut. The support on the over-arm holds the attachment rigidly in place, so that a comparatively heavy cut can be taken on carbon steel, at the same time holding the work to the close limit of 0.001 inch. The time per piece for finishing the worm is ninety minutes complete. As will be noted, a heavy supply of lubricant is thrown over the cutter and work.

* * *

An ordinance has been passed by the City Council of Budapest, Hungary, for the operation of trucks provided with taximeters. The cost of trucking will thus be based upon the distance covered.

Prices, Profits and Wages

By JACOB D. COX, Jr., President and General Manager, Cleveland Twist Drill Co., Cleveland, Ohio

IN an article, "The Economics of the Wage Problem," published in August MACHINERY, page 907, the author showed that the high wage level in the United States is due to the high average productivity of labor here, while the lower wage levels of Europe and the Orient are due to the lower averages of productive accomplishment there.

Why Business is not Always Profitable

To make the next step in our argument we must give attention to the factors influencing prices and profits in modern industry. Modern industrial production is competitive, and competition tends to regulate prices at such a point as will just permit the weaker producers to survive and continue in business. It is well understood by business men that when there are too many firms in business and too much productive capacity to supply the needs of the market, prices tend to decline, and if not interfered with, will continue to do so, until the surplus productive capacity has been squeezed out.

At such a time we have a rising failure rate and a chorus of complaints from business men, expressed in such slogans as "Profitless prosperity" and "Red ink expansion." We have been passing through such a period during the last seven or eight years and the end of it is not yet in sight. Either the excess equipment now existing must be eliminated by failures and obsolescence, or the needs of the market must grow and absorb the surplus of productive capacity, before business can become reasonably profitable again.

On the other hand should profits become unusually attractive in any line, capital is drawn there at once in large volume, productive capacity is increased, and through the resulting competition, profits are reduced again to a normal level. Statistics from Federal Income Tax returns show that an average of 40 per cent or more of all business enterprises in this country are conducted at a loss. In the last ten years the percentage of losing enterprises has ranged from as low as 34 per cent in 1917, and again in 1919, to as high as 52 per cent in 1921. The average is above 40 per cent.

The Wage Earner's Share

This condition referred to is surely too familiar to need elaboration, yet it seems doubtful that many people have taken the next step and drawn the obvious conclusion that the wage earners, in fact, receive in their pay envelopes the residual share of production. Profits, as we have seen, are strictly limited by the competitive process; and the limits of other forms of income, such as interest, rent, prices of land and raw materials are regulated by well understood laws which have been described at great length by economists.

It must follow, therefore, that when real increases in productive efficiency take place, the wage earners are the primary beneficiaries. This is well illustrated by the experience of the last few years; and it is common knowledge that the purchasing power of wages today is some 30 per cent higher than before the war. What is perhaps not so well understood is that this has been a continuing process over a long period of years—in fact ever since modern industry began.

Charts of wages paid in this country extending back over a period of a hundred years show a continuous steady advance in the reward of labor, while charts of commodity prices over the same period show a see-saw sidewise movement resulting in but slight total change over the entire period. The purchasing power of wages today is easily three times that enjoyed by the wage earner of a hundred years ago. This progress has been more or less constant and continuous throughout the whole period, though accelerated in times of keen competition and small profits such as the present period. If we ask how such progress has been made possible, the answer is that clearly it is due to the increased efficiency of modern large-scale industry.

Superior efficiency is the only sure method of obtaining profits in industry, for competition holds prices to a level that just permits the less efficient producers to stay in business; and it is only by achieving efficiency much ahead of the average that substantial profits can be made. The wage-earner's standard of living also depends on productive efficiency and advances steadily as industry, as a whole, becomes more efficient. This makes the interests of employers and employes identical in so far as the effects of productive efficiency on their welfare are concerned.

The High-wage Fallacy

Higher productivity, we have shown, is the cause of higher wage levels in the more advanced countries, and higher productivity we now see is the cause, also, of greater purchasing power of wages and a better standard of living for the wage earners in these same countries. Hence it appears that high wage levels and high standards of living go hand-in-hand, as both are the result of the same cause, and consequently appear everywhere together. The common man in view of this fact has jumped to the conclusion that the higher standard of living existing in the more advanced countries is due to their higher wage levels, and further that higher wages are the solution of all his difficulties.

We are surely in a position to see now the fallacy of such a ready-made conclusion and to understand also how it has become such a general belief. But even if the explanation we have given were not sufficient to show it to be a fallacy, still the expe-

rience of the last few years would demonstrate conclusively that there is something wrong with the common belief in the efficacy of high wages.

The Lesson Taught by the Past Ten Years

During the World War wages doubled, or more than doubled, in every civilized country, yet to the surprise of the average man there was little or no improvement in the standard of living. The first reaction from this phenomenon was to raise a furious outcry of "profiteering," but as time went on it became more and more apparent that something more than profiteering produced the result.

As every kind of price took its turn in rising, more or less in step with the rise of wages, it became apparent that civilization had entered a vicious spiral of rising wages, rising costs of production, rising prices and rising rents, which put all classes from wage earners to landlords upon a merry-go-round and gave them all a fine ride, but brought no benefit to any one. The standard of living not only did not rise in proportion to the rise in the wage level, but did not rise at all, and to this day the standard of living in most European nations is actually below what it was before the war.

The 30 per cent increase in the purchasing power of real wages, which has occurred in the United States, is unique and has not been duplicated in any other country. Even this rise did not occur during the general period of inflation, but came into existence, strangely enough, on a falling market for labor and commodities, and was the accompaniment of a marked increase in labor efficiency. Statistics showing the extent of the productive increases in various industries are too common to need elaboration here, but it is noteworthy that the average increase in productive efficiency of labor, parallels almost exactly the 30 per cent gain in wage purchasing power.

Surely if any proof were needed that high wages are not the secret of high living standards, but that high average productivity is the answer, we could hardly ask for a more striking demonstration than has been furnished by the experience of the last ten years.

Mutuality of Interests of Employer and Wage Earner

Business profits, we have seen, are strictly limited by competition; consequently the wage earners receive in their pay envelopes the residual share of production, after all other expenses have been paid. This means clearly that the worker's standard of living depends on productive efficiency and will advance steadily as industry becomes more efficient. It also means, of course, that the wage earners pay for all inefficiency in the productive process and should have the strongest incentive, if they but realized it, for building up efficiency in every line. This makes their interests identical with those of the employer in this direction.

Superior efficiency is the only sure method of obtaining profits in industry, for competition holds prices to a level that just permits the less efficient producers to keep themselves alive, and it is only by achieving efficiency much ahead of the average that substantial profits can be made. When such superiority is attained it at first benefits the employer only, but in time the methods of the most successful managers are adopted or copied by the main body of business men, and then competition compels the benefit of the new method to be given to the public in lower prices.

How the Savings Due to Increased Efficiency are Distributed

At first a more capable individual finds the way, earns a substantial profit for himself; and in doing so, serves as a pioneer and example for his competitors who strive to overtake him. This is the history of practically every successful business or business man. Mr. Woolworth developed the Ten-cent store operated as part of a chain, and now there are imitators and competitors in every hamlet. Woolworth made a huge personal fortune, but no doubt a much larger sum has been saved for the public through the short cut in distribution which he discovered.

The worker's interest in improved methods is not so immediate or direct as the employer's, but it is only just a step around the corner; and today it is becoming quite the usual thing for his interest to be directly and immediately recognized, either through profit-sharing or by the sale of stock on advantageous terms. Such a device makes the mutuality of interest between employer and employe more apparent and real, and undoubtedly is destined to a much more general use among progressive and successful employers.

Taking a wide view of industrial history it is clear that never has any society been so progressive nor made such rapid advance as have the American people in recent years. The keynote of this progress must be found in the unequaled opportunities for individual profits. The profit-making incentive has been an indispensable factor without which we could not have reached our present status, nor have attained the present standard of efficiency. The American method of organizing society on the principle of equal opportunities for all, and the great possibilities of profit for the successful individual in our large homogeneous market, have proved the most effective stimulus to progress that has ever been discovered, and by the same token the most effective promoters of the welfare of the wage earner.

The principal tool used by modern industry in the accomplishments of this advance has been

The principal tool used by modern industry for obtaining increased efficiency has been large-scale production, which has made possible specialization both in labor and in management, and has encouraged research and scientific progress on a scale never known before. Labor-saving machinery also has made a very great contribution. The popular notion has been that labor-saving machinery has caused unemployment and hardship for the workers, while, clearly, it has raised the standard of living of all. There have been temporary hardships for a displaced worker in finding a new job; but more efficient methods soon create new jobs with wages that have greater buying power than formerly. In the long run, labor-saving machinery has benefited all classes.

large-scale production, which has made possible specialization both in labor and in management, and has encouraged research and scientific progress on a scale never before seen. Labor saving machinery, also, has made a great contribution.

The Old Ideas on Labor-saving Machinery Compared with the New

It is extremely interesting to compare the old ideas on these subjects with the realities. The popular notion has been that labor-saving machinery caused unemployment and hardship for the workers, while clearly the reality is that it has raised the standard of living for all of us. It is true there is some temperorary hardship for the worker who is displaced, in finding a new job, but as a rule this is a temporary condition only, for the lower prices made possible through the use of more efficient methods release for other uses public purchasing power which soon creates new demands and new jobs for the displaced workers. A little time is all that is necessary to permit adjustments to be made. In the long run the process is highly beneficial to all classes, and the wage earners most of all. Labor-saving machinery should really be called "Plenty-creating machinery," for that is its real function.

The Effect of Employing Labor on a Large Scale

Large-scale employment also has been the subject of bitter attack on the ground that it places undue power in the hands of the employer and enables him through that power to oppress the worker and reduce him to a lower standard of living. Surely no conception could be more completely contrary to facts. The large-scale employer usually does not enjoy any advantage in employing labor, but is actually at some disadvantage as compared to the smaller employer, for he must have labor wholesale and cannot shop about to secure men whose temporary disabilities might incline them to accept work at less than the market rate of wages. So, as a matter of fact, large employers are usually found paying just a little higher wages than small ones.

It is true that the large industry located in a remote or isolated district may at times have a practical monopoly of employment, but this is a sword that cuts both ways, for an industry so located finds it quite as difficult to attract men to its remote location and build up its forces when business makes that necessary, as it is difficult for the wage earners to emigrate and find jobs elsewhere when business slows down. The modern labor policy of such large employers is to shorten the working week when business is slack, and so preserve a skilled and stable working force that will be available for expanding production when business picks up again.

On the whole, the effect of large-scale employment has been to stabilize the wage market and to bring greater assurance of fair dealing into all wage relationships. A parallel from modern merchandising experience will make the matter clearer. In the early days when trading was on a small scale the motto of business was "Let the buyers beware." Large scale merchandising has changed that condition entirely today. Every reputable store prides itself on the quality of its merchandise and the fairness of its prices, which are all marked in plain figures and alike to all comers. Large scale merchandising cannot be a success on any other terms, and the motto of the modern merchant has reversed itself and been crystallized in the expression "The customer is always right." Very much the same thing has occurred in the labor market. Large employers of today are jealous of the reputation of their companies for enlightened fair dealing with employes, and strive to maintain the good will of their working forces exactly as the large merchant recognizes the essential value of customer good will to his business.

If the real identity of interest existing between employer and employe could be generally recognized in public thought, an immense step forward could be gained for good industrial relations. Unfortunately, the old idea of a conflict of interest between employer and employe still seems to prevail in most quarters, and particularly among those classes who are inclined to take a theoretical and academic interest in the subject. In fact, these people seem to be farther away from a clear conception of the real facts than any other group—farther than the wage earners themselves, who are generally much better informed, and who recognize the mutuality of interest to a far greater degree than those outside of the industry who claim to be disinterested critics of conditions.

The Best Wage Level for All Concerned

The interests of wage earner and employer are also in real harmony with regard to the wage level. We have seen that a general level of wages which is too high causes loss of export business and even of home markets and so results in industrial stagnation and unemployment. We have also seen that the general level of wages has an insignificant effect on the standard of living, the latter being governed not by the absolute height of the wage level, but by the efficiency of productive effort. It is clear, therefore, that the wage earner and employer have no occasion to quarrel over the general level of wages existing in any country. It is to the interest of both to have the level established at the height naturally determined by the free working of economic forces, so that full employment will obtain and approximately full operation of industry. This is the best level for all of us regardless of whether it may seem high or low.

If the real identity of interest existing in this field could be generally recognized in public thought, an immense step forward would be gained for good industrial relations. Unfortunately the old idea of the conflict of interest between employers and employes still seems to prevail in most quarters, and this is especially true among those classes who are inclined to take a theoretical and academic interest in the subject. Of all people, they ought to be the best-informed. But the old ideas have held sway so long and have become so firmly rooted in public consciousness that those who have the academic viewpoint seem to be farthest of any group from understanding the essential realities of

the situation, farther even than the wage earners themselves, and it is from such least informed groups that the most radical criticisms of modern industry chiefly emanate. The workers themselves know better and are far less radical.

The Old Ideas Must be Discarded

Surely it is time that the ghosts of these old ideas should cease to embitter employment relations. Such old notions as the "Iron law of wages," which held that the wage earners could never rise above the barest level of subsistence, should cease to color our thinking. The notion that workers as a class are robbed and exploited by capital and deprived of their fair share of the product is another of those foggy theories that must yield before the sunlight of modern facts. Good citizens surely have a duty to hasten this process and to bring about a general recognition of the new realities in place of these old superstitions.

The wage earners themselves see the light except where they have fallen under the influence of organized propaganda of the old school. The idea that it is necessary for wage earners to be organized on the basis of militant force in order to preserve their standard of living is a survival from the dark ages, and is certainly losing its attractiveness and appeal to the present generation. Only a few of the old "die-hards" still cling to these notions, but the organized ranks marching behind them are steadily dwindling away.

The great mass of the people have grasped the idea that intelligent cooperation between employer and employes is capable of accomplishing far more for the general welfare than the old program of embattled classes ever could. The old ideas were never native to this country, but were an alien importation which flourished for a time, but can no longer thrive in our clearer air. What is needed to complete the process is a clearer public conception of what are fair wages and how they are to be obtained.

[This is the second article by Mr. Cox on the economic basis of fair wages. A third article entitled "Industrial Prosperity and Fair Wages" will be published in October MACHINERY—EDITOR]

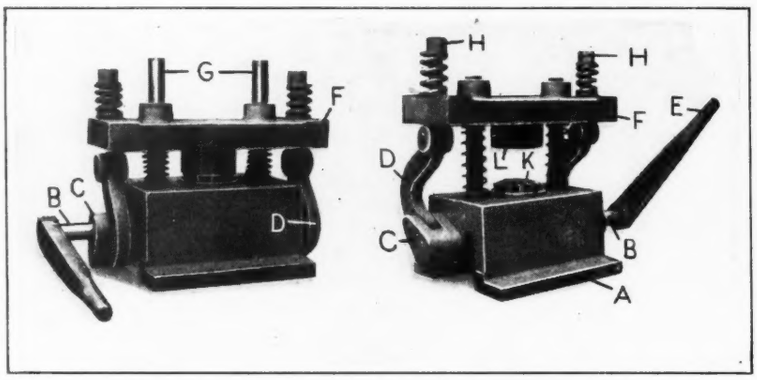
* * *

QUICK-ACTING DRILL JIG

By J. J. LINTON

In the accompanying illustration are shown front and rear views of an improved quick-acting drill jig. The action of this jig is simple and yet so positive that it gives satisfactory results when used by unskilled operators. The jig can be opened and closed with one hand while loading and unloading with the other. These operations may be performed so quickly that it is possible for one operator to run a battery of four or five drills. The jig base *A*, which is made of gray iron, has a 1 1/16-inch diameter shaft *B* passing through a bearing at each end. The cranks *C*, at each end of the jig, are attached to shaft *B* with taper pins. At the outer end of these cranks, 2 inches from the center of shaft *B*, are attached, by pins, the bent links *D*.

The handle *E* is attached to shaft *B* with taper pins. By moving this handle 180 degrees or less, the bent links are made to raise or lower bushing plate *F* on the guide pins *G*. The eye-bolts *H*, which have double nuts on the top ends to retain the springs, are attached to the bent links. This construction allows adjustment for any desired pressure on the work when the jig is closed, as shown in the view to the left. The lower ends of the bent links rotate past the center a slight amount at the end of the closing movement so that the jig is locked in the closed position. The piece *K* shown in the jig is a bevel pinion. The work in this case is located in a hardened steel ring pressed into the base, and is prevented from turning by a pin in the locating ring. The hardened drill bushing *L* presses on the work and holds it in place.



Quick-acting Drill Jig in Closed and Open Positions

When the jig is used for spur pinions, a locating cone is used on the top member and a flat plate under the work. This permits the work to float into position. The jig can be adapted to handle pieces of many different shapes. The operating handle, the cranks, and the bent links are made from gray iron castings.

* * *

CAM MILLING ATTACHMENT

The method of milling closed track cams described on page 851 of July MACHINERY is not theoretically correct, and its use, except for comparatively rough work or for cams that have very flat pressure angles, may result in a spoiled job. In cutting closed track cams, it is a fundamental rule that the track or groove must be cut with a milling cutter of the same diameter as the cam roll. This is necessary because the two sides of a cam track are equidistant, when measured along a line normal to the pitch line, but not when measured on a line through the center of the camshaft, except on the concentric or dwell portion of the groove.

The error will be apparent, in cutting a steep rise cam, if the positions of the cutter and guide are shown in the middle of a very steep rise instead of in a dwell portion of the groove. In the writer's opinion it is quicker, and in any case it is more accurate, to make a former or master cam and cut both sides of the track simultaneously and to full depth.

P. R. H.

Letters on Practical Subjects

REBORING MOTOR-BUS BRAKE-DRUMS ON MILLING MACHINE

A few weeks ago, a job came into the shop which was too large to swing on any of the lathes. Ordinarily, we would have suggested to our customer that the job be taken to another firm having equipment of suitable size to handle it. However, as there was not a great deal of work in view, we wished to keep the job in our own shop and so arranged to handle it in the manner to be described.

The job consisted of forty motor-bus brake-drums of the construction shown at *X*, which were worn badly on the inside, and more or less eccentrically on the 16.010-inch diameter. The problem was to bore out the inside so that it would run true, at the same time removing as little stock as possible. In order to do this work without a lathe or boring mill large enough to swing the pieces, a milling machine was set up as shown.

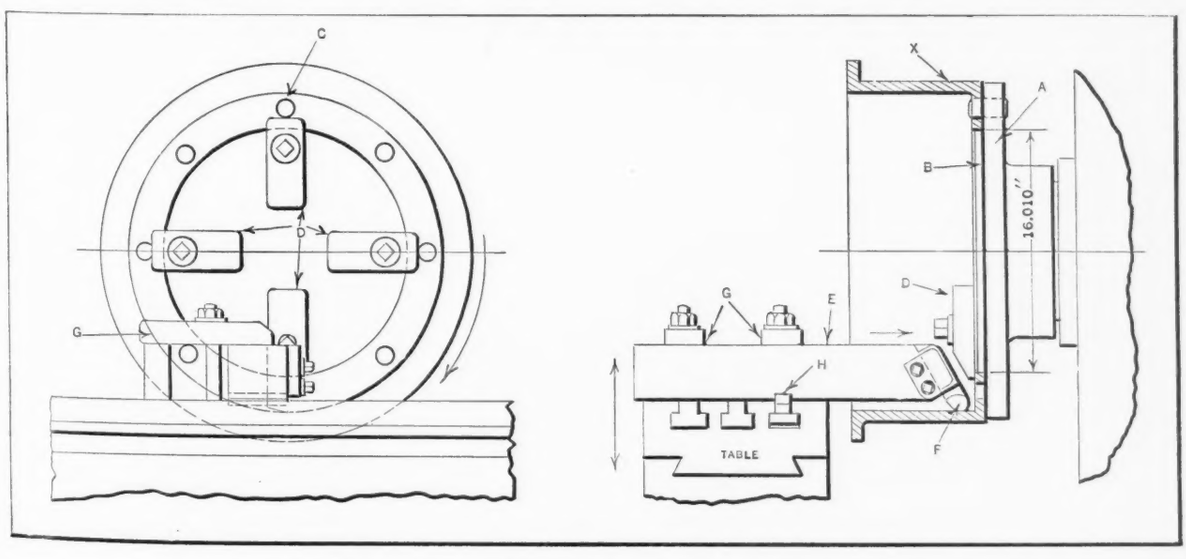
A large faceplate *A*, fitted with a steel pilot ring *B* to fit the 16.010-inch hole in the brake-drums, was mounted on the milling machine spindle. A locating pin *C* was employed as a driver in one of the flange bolt holes. Four ordinary strap clamps *D* were used to hold the work back against the faceplate. The boring-bar consisted of a piece of 3-inch square stock *E* which was provided with a tool *F*. A tongue or key *H* located the bar on the table, and it was held in place by two heavy strap clamps *G*.

In using this equipment, the work was located on the faceplate pilot and clamped in place. Then, by raising and lowering the table and using the "in-feed," the work was bored accurately to the required size. Of course, the machine was hardly as convenient for the operator as a large lathe or boring mill, but it was rigid, and there was no appreciable chatter. A. A. D.

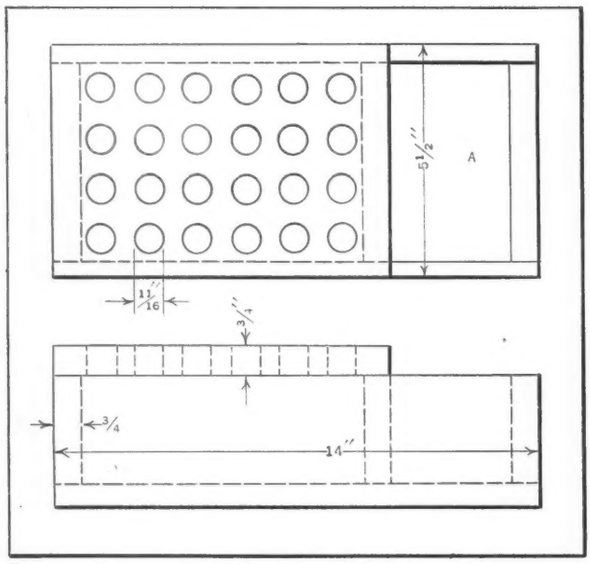
BOLT RACK FOR THE DIE SETTER

The cost of die setting on small-lot runs is an important factor in the total production cost, especially where it is charged directly to the operation. In the plant where the writer is employed, this cost has been greatly reduced by providing simple time-saving devices, such as the bolt and washer rack shown in the accompanying illustration. A rack of this kind is provided for all presses under the No. 4 size.

The 5/8-inch hexagonal screws, when not in use,



Set-up Employed on a Milling Machine for Reboring Brake-drums



Bolt and Washer Rack

are placed in the holes in the wood blocks, each row accommodating four screws of each length. The lengths cover a range of 1 3/4 to 3 1/2 inches long. The space at *A* is used as a receptacle for the washers. The construction of the rack, which is made of wood throughout, is clearly shown by the illustration. The holes for the bolts are so spaced that the heads do not interfere with each other.

The die setting cost averages fifty cents per operation, and in many cases this cost does not exceed twenty-five cents. To maintain this low cost, every convenience must be on hand for the die setter. For instance, a full set of wrenches and a rack for them is located on the wall or on a post near each press. It is a rule that the tool outfit for each press must be in its proper place when the die setter is ready to turn the machine over to the operator.

New Albany, Ind. E. A. SISSON

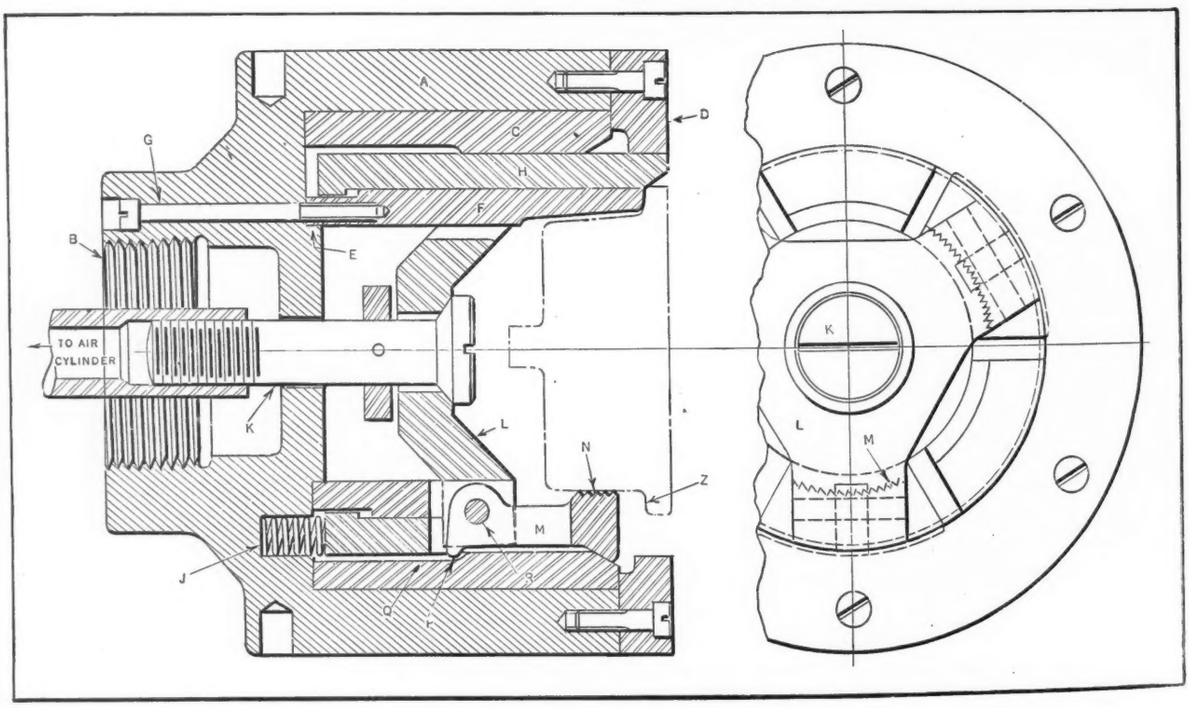
AIR CHUCK FOR BRASS CUP CASTING

An air-operated chuck for holding a brass cup casting while being machined in a turret lathe is shown in the accompanying illustration. As these brass cups are required in large quantities, the ordinary hand-operated three-jaw chuck proved too slow, and led to the development of the chuck illustrated.

The casing *A* of this chuck is threaded at *B* to fit the end of the turret lathe spindle. A hardened sleeve *C* is driven into casing *A*, and retained by the cap ring *D*, which is fastened by screws to the front of the casing. Fitting the shoulder *E* in the bottom of the large bore in the casing is the inner sleeve *F* which is fastened to the casing by the screws *G*. Between these two sleeves *C* and *F* slides the shouldered sleeve *H*, which stops against a shoulder on sleeve *F* and is forced toward the shoulder by the six springs *J*.

In operation, the casting is loaded in the front of the chuck, against the projecting chamfered sleeve *H*. The casting shoulder *Z*, by striking the chamfer on sleeve *H*, centralizes the cup casting, at the same time pressing back the projecting sleeve *H* against the pressure of the springs *J*, until the casting strikes the end of the inner sleeve *F*, which is so shaped as to position the casting, as shown in the illustration.

At this point, the air pressure is released by a hand valve. This draws back the screw *K*, the head of which pulls back the spider *L* with it. Pivoted to spider *L* are three equally spaced hardened chuck fingers *M*. The heads *N* of these fingers are shaped to fit the body of the casting, and are serrated to give a good grip. The backs of the serrated heads of the jaws *M* are beveled and fit a similar taper on the front of the outer sleeve *C*. Thus, on being brought back by a pull on the screw *K*, the fingers are forced toward the center and grip the work. On the completion of the machining, the fingers are brought forward until the dog-



Air-operated Chuck Used on Turret Lathe

shaped ends *P* strike the bottom of the bore *Q* in the outer ring *C*. This swings the fingers on pivots *R*, and brings the gripping heads away from the work. The work, being released, is forced out of the chuck by the sleeve *H*, which is moved forward by the action of springs *J*.

New York City — B. J. STERN

BENDING DIES FOR ACCURATE WORK

Bending dies for accurate work have always been a source of trouble to toolmakers. There are so many methods of bending a part and so many different kinds of metal that no fixed rule holds good for determining the amount of metal to allow for a bend. Generally, the holes are pierced and the form blanked before the bending operation is performed. For this reason, accurate information regarding the change produced in a part by bending must be had before the blanking die is made. The old-style V-notched die is still in use, but in many cases it will not bend two successive blanks alike. However, it answers for work not requiring great accuracy.

As a result of the demand for greater accuracy, the dies shown in the accompanying illustration were developed. These dies have proved very satisfactory. The die shown in Fig. 1 is designed for making right-angle bends in a lock part. It has a steel block *K* with a slot sawed in it to receive and locate the work during the bending operation. If the part to be bent is of irregular shape, it may be necessary to place a form *L*, of corresponding shape, in the bottom of the slot. A square or oblong hole *M* of suitable size is cut vertically through the die to receive the pilot *N* of the punch *O* and to prevent the punch from backing away from the work.

The punch is made with a radius surface *P* in the working corner to suit the radius of the bent piece. This radius can be determined by bending a piece of the same kind of stock in a vise. As the punch descends, the corner of the blank is pushed to one side by the radius surface. After the bend is started, the straight surface finishes the right-angle bend. This die is particularly adapted for producing parts in which the bend is required to be accurately located with respect to one side only. A greater allowance for bending is necessary when this method is used, as much as the full thickness of the stock often being required for the bend.

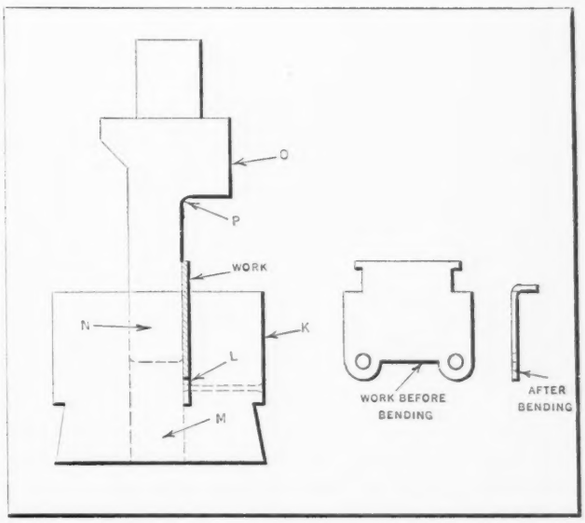


Fig. 1. Punch and Die for Making Right-angle Bend

Another successful bending die of novel design is shown in Fig. 2. This die is more expensive to build than the one shown in Fig. 1, but it possesses features that warrant the additional cost. It produces work of surprising accuracy if properly made. The die consists of a base *A* with a V-cut of

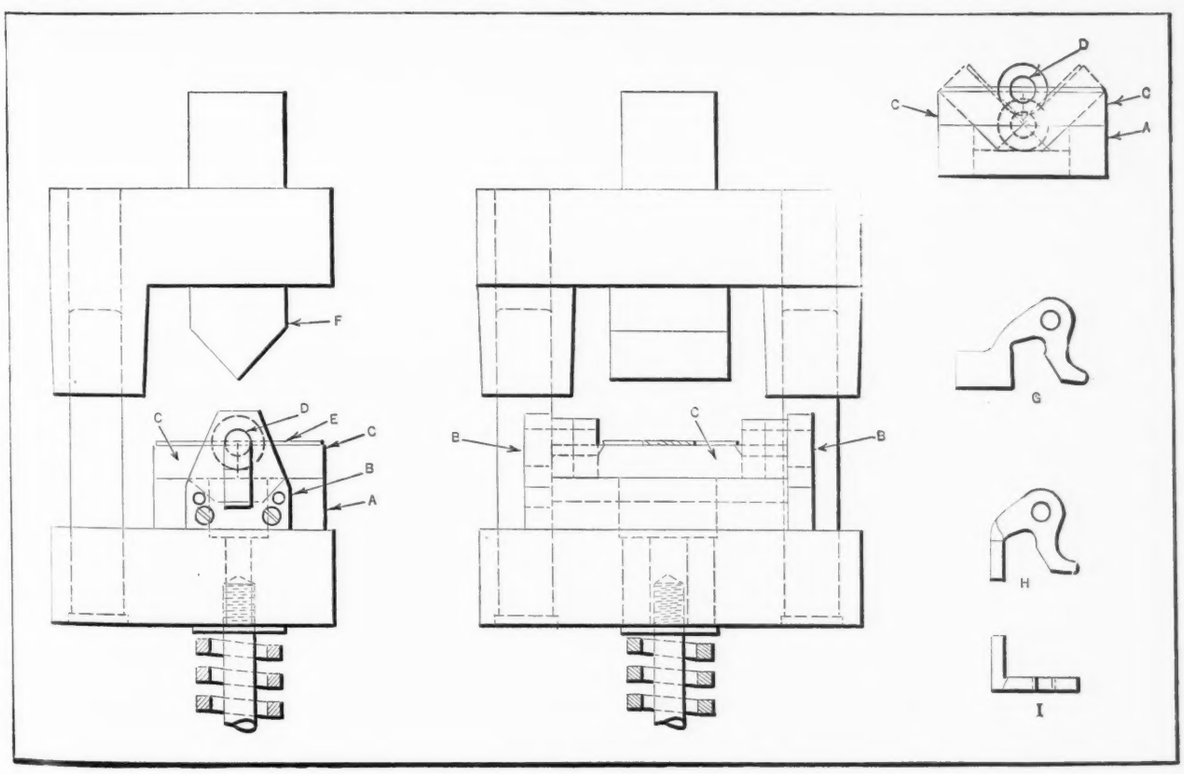


Fig. 2. Die for Accurate Bending

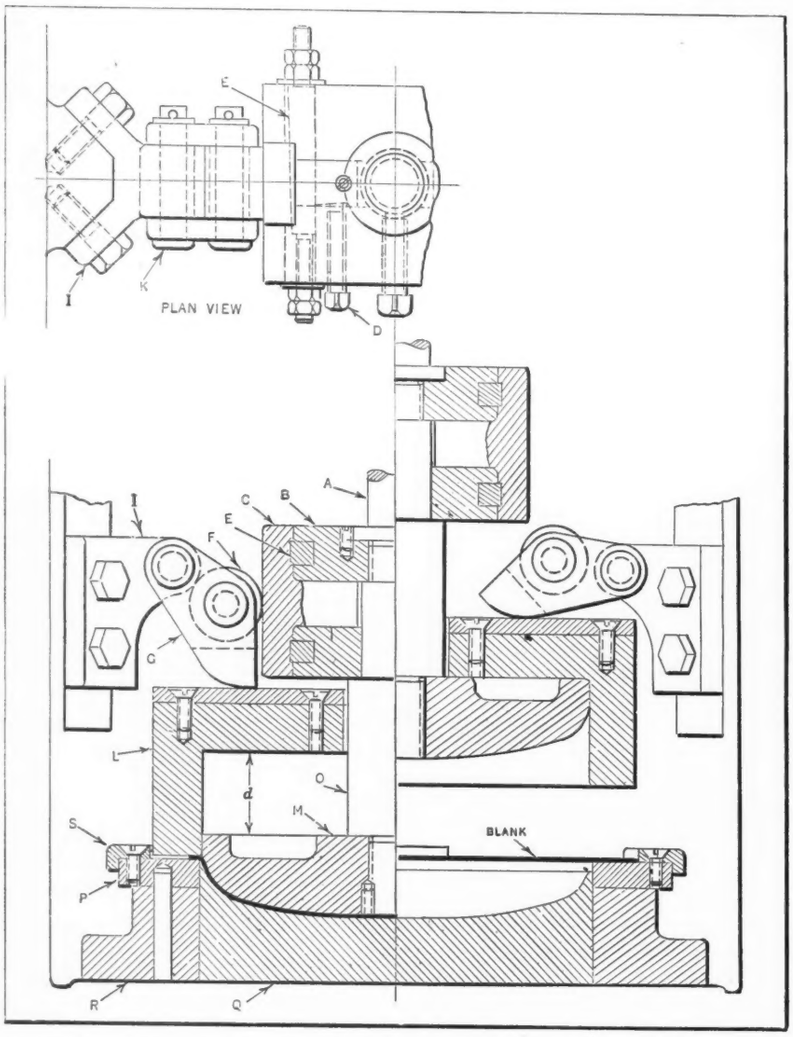
suitable size across the upper surface. A column *B* is fastened at each end to give support to the working members, which consist of two leaves *C* held together by a hinged joint. The hinge pins *D* slide vertically in the slots of the columns and keep the joint centrally located in the die. A suitable nest *E* for locating the work is firmly fastened to the leaves in such a manner as to bring the bend at the proper place. The working surfaces of the nest should be chamfered on top and slightly tapered toward the bottom to facilitate placing the work in position for bending.

The top surface of the leaves on which the blank rests must be located one-half the thickness of the stock below the center of the hinge pins, and in some cases slightly more. If found necessary after trial, the top surface may be ground down until the die operates satisfactorily. A rather heavy spring, located beneath the pillar press, serves as a knockout and also assists in the actual bending of the work, the pressure being so adjusted that the blank will bend as fast as the punch descends; otherwise, the blank will bridge the V-notch and exert pressure against the locating nest. Punch *F* is of the design usually employed for V-shaped bending dies.

The die is mounted in a pillar press to secure perfect alignment. The same die may be used for bending different shapes at right angles by supplying a separate nest for each shape. When the thickness of the stock varies, the leaves should have inserts of the propert height for each kind of stock. This is very important, as the blank will be stretched or crushed if the working surface is too low or too high.

When the die is in operation, the work is placed in the nest while the leaves are in the "up" position. The leaves are moved downward by the punch until they reach the bottom on the V-surface of the die. After the work is bent, the spring returns the leaves to their original position, and the work may be blown off the die by compressed air or removed in the ordinary way. This method has proved very successful on work that would be difficult to bend in the usual manner. The view at *G* shows the blank before bending, and the views at *H* and *I* show the part after the bending operation has been completed.

Reading, Pa. J. J. KAUFFMAN



Screw Press Die for Drawing Oval-shaped Shells

SHELL-DRAWING DIE FOR SCREW PRESS

The die shown in the accompanying illustration, for drawing an oval shaped shell 11 by 8 by 1 3/4 inches deep, is used on a screw press. The shell is required to be evenly drawn and smooth on the outside. A rather unusual feature for a screw press die is the blank-holder or pressure pad *L*. The right-hand half of the section view shows the die parts in their respective positions at the beginning of the down stroke while the left-hand side of the illustration shows the parts as they appear at the completion of the stroke.

The shank *A* is clamped in the ram of the press and is screwed into block *B*. The tool-steel piece *C*, which is held in place by screw *D*, is inserted in the block and can be accurately set or adjusted by means of the wedges *E*. The tool-steel roller *F* bears against the outer face of member *C*. The roller is held in lever *G*, which can be swung around pin *K*.

Bracket *I* is securely fastened to the ways of the press, and serves as a bearing for pin *K*. The blank-holder *L* is free and guided by punch *M*, which is the shape of the work. The punch is held in block *B* by the stem *O*. The drawing ring *P*, die *Q*, and the die-shoe *R* complete the die.

The blank is centered by the stops *S*. When the ram descends, the weight of the lever *G* causes it to turn or pivot on pin *K* until the blank-holder comes to a stop on the blank. While the holder remains in this position, the punch continues to descend. Before the punch strikes the blank, steel piece *C* makes contact with roller *F*, causing the end of lever *G* to press on blank-holder *L*.

On its up stroke, the punch *M* lifts the holder *L*, after it has traveled through the space *d*. The roller is thus raised out of contact with piece *C*, and lever *G* is allowed to swing back to its original position. A lift-out arrangement is provided which raises the die member *Q* sufficiently to permit the work to be easily removed. Dies similar to the one illustrated and described have been used successfully in the production of oval-shaped shells of various sizes.

Cicero, Ill. F. HEIDINGER

GAGE FOR CHECKING HOLE IN CONNECTING-ROD

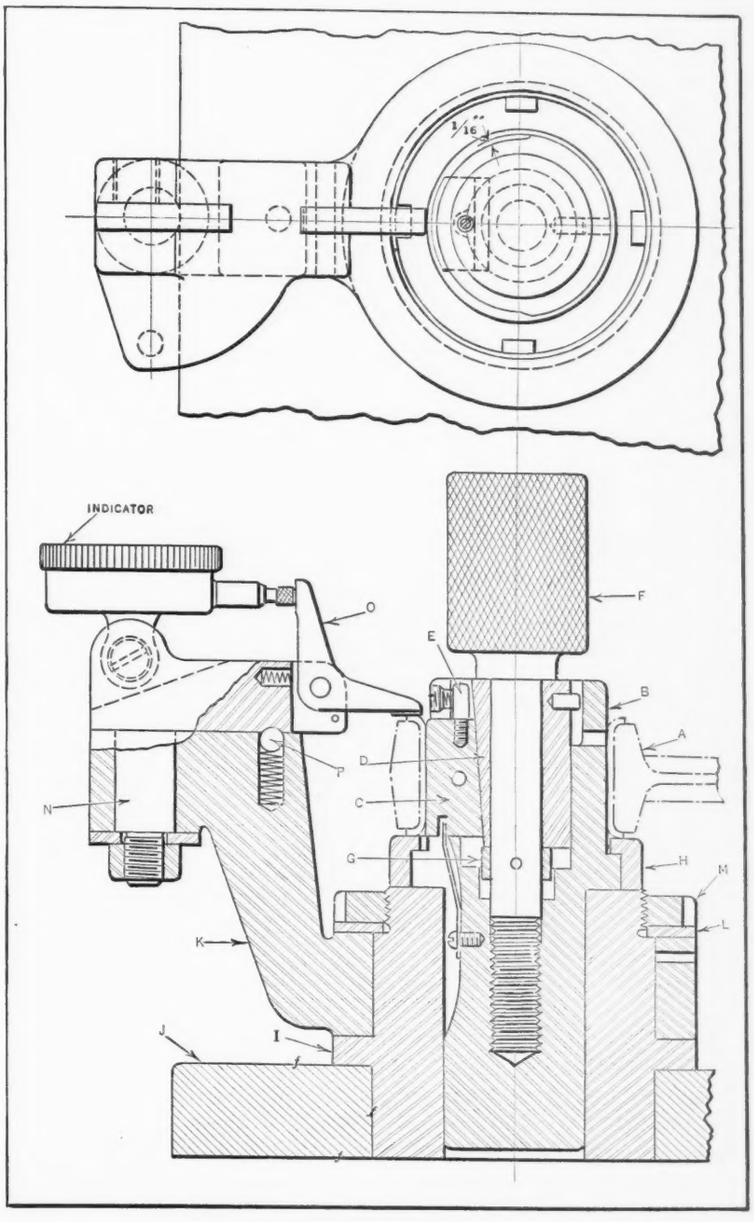
The gage shown in the accompanying illustration was designed to check the position of the hole in the large end of a connecting-rod, when it was discovered that the sides of the rods were not always at right angles to the axis of the hole. The gage was also used to check the width of the rod by setting the indicator to the zero point with a standard or master rod in position.

The connecting-rod, shown by dot-and-dash lines at *A*, is held on a stud *B* which has half its periphery machined to the diameter of the connecting-rod hole, and the other half to a diameter 1/16 inch under size, as shown in the top view. Stud *B* has an inserted block *C*, which is moved in and out by part *D*. The latter part is cylindrical and has a tapered flat on one side. Block *C* is held against the flat side of part *D* by two springs, one of which acts against the pin *E*. Part *D* is a working fit on part *F* between the shoulder and collar *G*.

When part *F* is turned by means of a knurled handle and screwed in and out of stud *B*, part *D* moves up and down, which, in turn, moves block *C* in and out. Inserted in part *D* is a pin which runs in a keyway in part *B* and allows *D* to move up and down but prevents it from rotating. When the connecting-rod is placed on stud *B*, the knurled handle is turned and block *C* is tightened against one side of the rod, the other side being located by the full periphery of the stud. Part *H* is a collar which is pressed on stud *B* and has a hardened and ground surface on which the connecting-rod rests.

Stud *B* is pressed into part *I* which is, in turn, pressed into the base *J* and serves as a case for the gage. Part *I* acts as a bearing around which the member *K* may be rotated. The latter member is a working fit on *I*, and is held in place by washer *L* and nut *M*. Part *N* holds the indicator and finger *O* which rests on the work and acts against the indicator. Finger *O* is kept in contact with the work by a small coil spring. The member *N*, which can be revolved about its stud bearing, can be located in one of two positions by means of a spring-actuated ball *P*, which snaps into depressions in the lower bearing surface of member *N*. In one position, the indicator and finger *O* are out of the way, so that the work can be put in place or removed. In the other position, the indicator is properly located for testing the work.

When the work and the indicator are in their proper positions for testing, part *K* is rotated about member *I*, thus permitting the side of the connecting-rod to be tested by the indicator at practically all points. The squareness of the sides with respect to the axis of the hole can thus be readily tested.



Gage for Testing Squareness of Hole with Sides of Connecting-rod

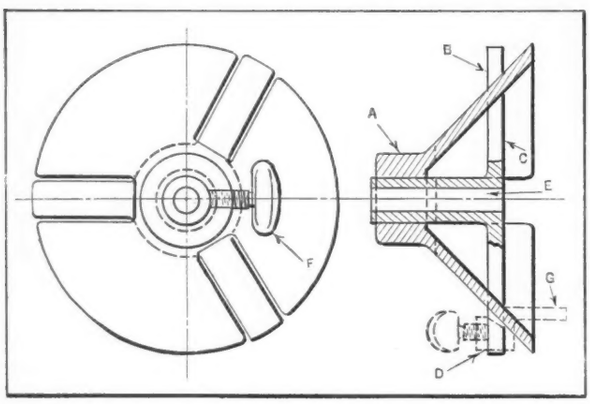
Kenosha, Wis. CHARLES F. STEIN

SELF-CENTERING JIG FOR DRILLING CENTERS IN LATHE

The drill jig shown in the accompanying illustration will save time in centering or center-drilling bar stock of almost any cross-sectional shape or size, including round, square, and hexagon bars.

The jig consists primarily of two parts, *A* and *B*. Part *A* is cone-shaped and has three or four slots in which the radial legs of part *B* slide freely. The jig is centered on the end of the work to be drilled by the cone-shaped part, while the face *C* of part *B* serves to line up the drill or center-punch hole *E* at right angles with the surface to be centered.

This type of jig has proved useful in repair work, where the original center has been removed by machining operations. A thumb-nut *F* may be provided for locking part *A* to part *B*. Extra attachments like the one shown at *D*, which may be slipped over the radial legs on member *B*, can be used, in some cases, to give the jig a chuck-like hold on the work. The gripping faces *G* of the attachments may be machined concave to conform with the mean radius of the cone member, or they may be made with a very broad vee having an included angle of, say, 160 or 165 degrees between the faces, in order to give them a two-point bearing.



Self-centering Jig for Drilling Centers in Lathe

In some cases the jig itself may be used as a makeshift lathe center. When equipped with a punch that is a good fit in the central hole, the jig makes an excellent adjustable center punch.

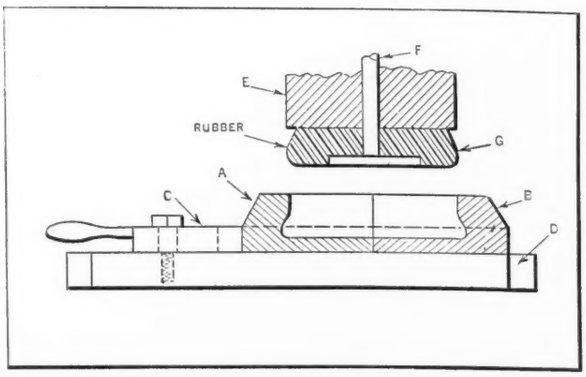
Johnstown, Pa. CHARLES H. MARTIN

SWELLING DIE FOR ALUMINUM SHELL

A die for swelling the bottom of an aluminum coffee percolator, to give it a larger heating surface and improve its appearance, is shown in the accompanying illustration. It consists essentially of a split die member having a forming cavity, and a punch member with a rubber pad secured to its lower end. When the rubber pad hits the bottom of the shell, it is squeezed out, causing the shell to fill the cavity in the die.

The baseplate *D* has a 15-degree dovetail slot machined on its top surface to receive the split members *A* and *B* of the die. Compression coil springs located in holes at each side of the die cavity force slide *A* outward when cam *C* is swung around, thus opening the die so that the shell can be removed.

The pin *F*, which holds the rubber swelling member *G* to the end of punch *E*, is retained in the latter member by a cross-pin in its upper end, which slides in a slot cut in punch *E*. In making this die, the baseplate was first planed to size, after which the two halves *A* and *B* of the die were pressed in the dovetail slot. The whole assembly



Section through Split Die and Rubber Swelling Punch

was then secured to the faceplate of a lathe and the cavity formed. The member *A* was then relieved equally on both sides to give a close sliding fit in the dovetail slot.

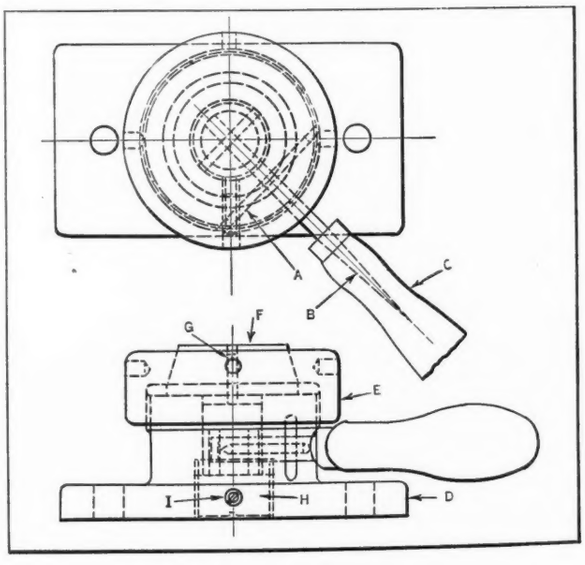
In operation, a shell is placed in the cavity of the closed die and the press tripped, causing the punch to descend. The punch *E* forces the member *G* against the bottom of the shell, causing the rubber to expand and force the shell out into the cavity of the die. On the up stroke, the pressure on the rubber member *G* is released, allowing it to regain its original form while being withdrawn from the shell. The die is then opened and the swelled shell removed.

Navarre, Ohio GEORGE CASTER

SCREW CAP HOLDER FOR SMALL DIES

A screw cap die-bed or holder which has been used with very good results for holding forming dies for very small metal parts is shown in the accompanying illustration. It consists of a base *D* which is threaded at the top to receive the nut *E*. Nut *E* holds the die-block *F* securely in position. The adjusting nut *H*, which is locked by the set-screw *I*, is used to back up the knock-out plug *G*. An ordinary file handle *C* is fastened to the lever *B*, which is mounted on a fulcrum pin *A*. This handle operates the knock-out plug *G*.

Rochester, N. Y. EDWARD T. HEARD

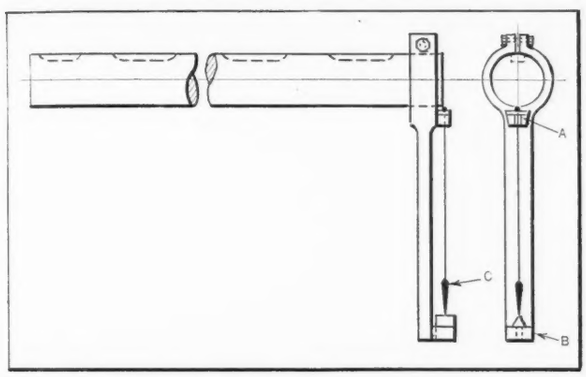


Holder for Small Forming Dies

LINING-UP FIXTURE FOR CUTTING INTERMITTENT KEYWAYS IN LONG SHAFT

The plumb bob fixture shown in the accompanying illustration is used for relocating a long shaft when milling several keyways in line. The particular shafts for which the fixture was designed were 4 7/16 inches in diameter and 8 to 18 feet long. From eight to ten keyways were required to be milled in the shaft, in line within reasonable limits of accuracy. Before the fixture was made, the shafts were located by means of a height gage and angle-plate, the keyway milled last being used to line up the shaft for the succeeding cut. This was rather a slow and inconvenient method, particularly as it was necessary in some cases to use parallels in order to extend the gaging surface beyond the end of the milling machine table.

The construction and method of using the new fixture may be easily understood by reference to the illustration. The cast-iron body of the fixture is bored out at one end to fit the shaft. The end



Fixture for Locating Long Shaft when Cutting Several Keyways in Line

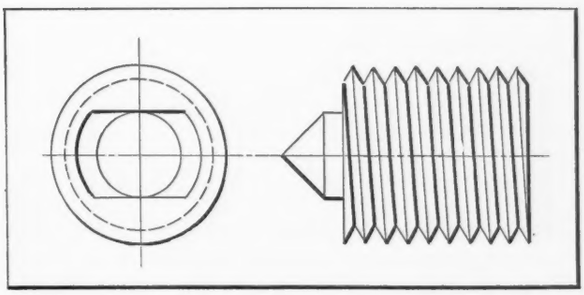
is slotted and a clamping bolt is provided for securing the fixture to the end of the shaft. A slot is milled through the lugs *A* and *B* on the face of the fixture. These slots line up with the center of the hole bored to fit the shaft. Steel pieces are made to fit into these slots. The one in the top lug is drilled through the center to receive the upper end of a cord having a plumb bob *C* attached to its lower end. The steel piece inserted in the lower lug has a knife-edge.

After locating the shaft on the milling machine table and centering the cutter, the fixture is attached as shown in the illustration. The point of the plumb bob is lined up with the knife-edge. The fixture is left clamped to the shaft, being brought back to permit the shaft to be moved up before lowering the table from the cut. If necessary, the fixture can be transferred to the opposite end of the shaft while the cutter is in one of the keyways being milled. This simple locating device has proved satisfactory and eliminated the errors that frequently crept in when using the old method.

Detroit, Mich. LESLIE G. KORTE

CENTER-PUNCH WITH THREADED BODY

The center-punch with a short threaded body shown in the illustration is used for locating the holes for the body screws in a plate or member to be secured to a piece in which the threaded holes do not extend all the way through. Punches of this



Threaded Punch for Locating Holes in Matching Part

kind are used successfully in building up dies, the method being to machine, drill, and thread the tool-steel parts before machining the die-shoe. This allows the tool-steel parts to be ground all over after hardening, and permits fitting the shoe to the finished piece instead of employing the reverse method of fitting the pieces to the shoe, with no opportunity for grinding after hardening.

When the die is ready for assembling, the punch is screwed into the threaded hole by means of a pair of pliers which grip the two flattened sides near the point. The point is allowed to project about 1/64 inch. The piece to be marked is then carefully located in its proper position in the shoe, and tapped lightly with a hammer to obtain a distinct prick mark. For a heavier impression, the regular center-punch should be used, so that there will be less wear on the fine point of the threaded punch. Punches of this kind have been used for several years without experiencing any trouble from misalignment of the assembled parts.

New Albany, Ind. E. A. SISSON

STAND FOR OVERHAULING AIR PUMP

A convenient stand for holding a locomotive air pump while it is being overhauled is shown in the accompanying illustrations. All sizes and makes of air pumps can be held on this stand by the use of interchangeable tables or frames. The stand is pneumatically operated, and can be manipulated to bring the air pump into any position desired with-

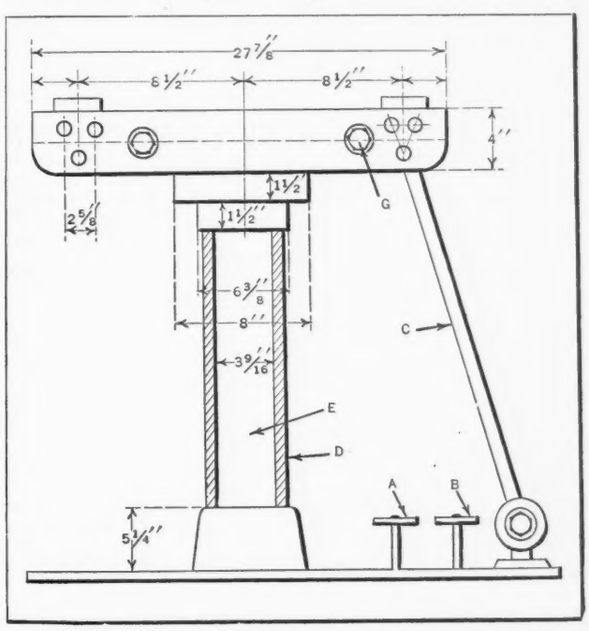


Fig. 1. Overhauling Stand for Air Pump

out the use of a hoist or crane of any kind. In Fig. 1 the stand is shown in a horizontal position, raised to the maximum height above the floor. At *A* and *B* are the compressed air valve handles which control the raising and lowering of the stand.

The rod *C* is used to tilt the pump stand to an angle, as shown in Fig. 2. When an air pump has to be held at the maximum height for some time, a heavy split and hinged sleeve *D*, Fig. 1, is placed around the column *E* to support the pump. A specially constructed cylinder *F*, Fig. 2, can be used for raising the stand or a suitable cylinder can be

After the stand has been placed in the position shown in Fig. 1, the locking pin *G* is replaced and secured by the latch *H*, Fig. 2. The connecting-rod *C* is then removed, and the holding sleeve *D*, Fig. 1, placed in position, after which the air valve *B*, Fig. 2, is closed and the exhaust valve *A* opened to release the air from the cylinder. Air must always be admitted to the cylinder before removing the holding sleeve, as otherwise the stand would drop to the floor.

In Fig. 1 the stand is shown in the horizontal position with the locking pin *G* and the connecting-rod *C* in position. Auxiliary tables can be made

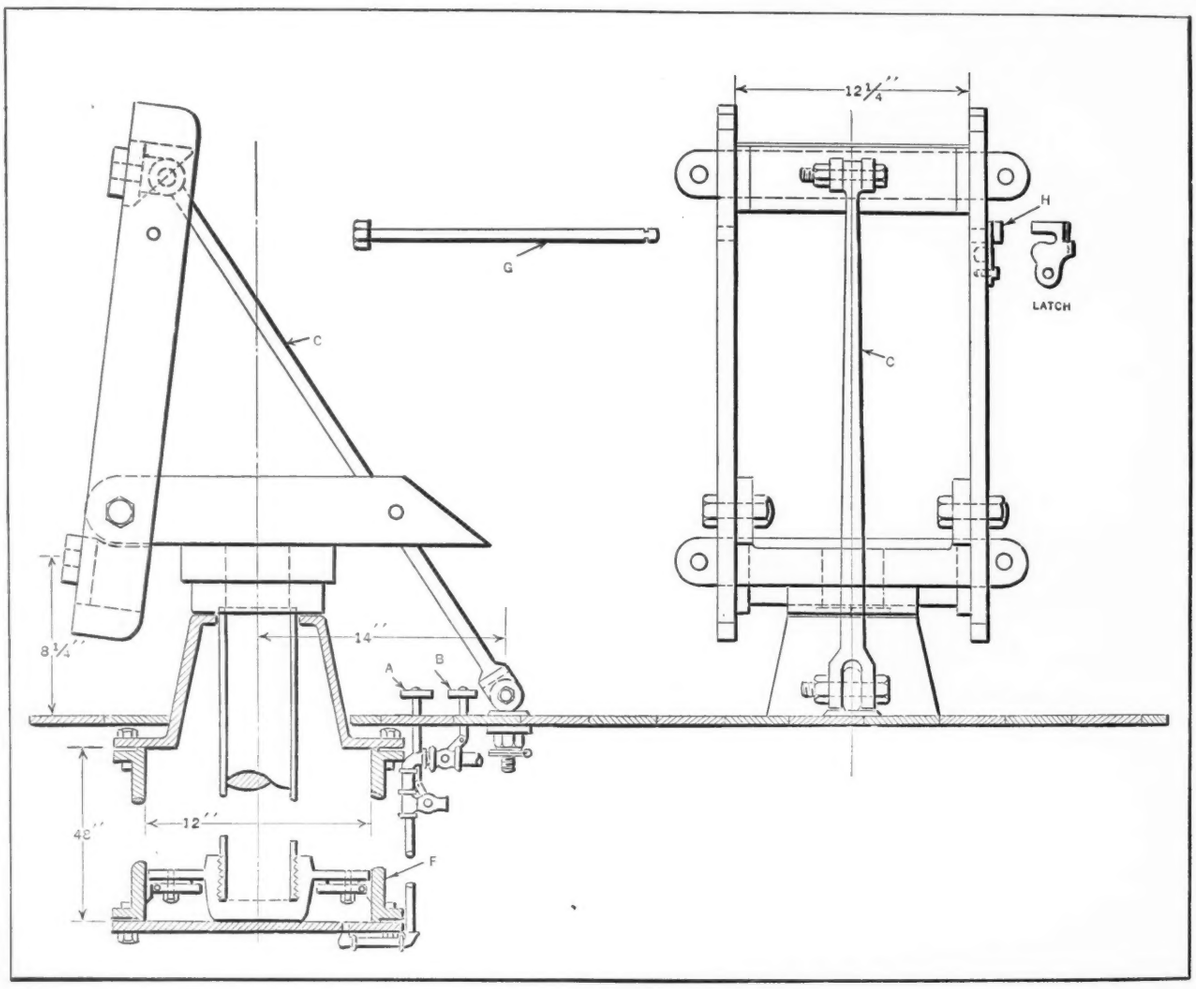


Fig. 2. Stand Shown in Fig. 1, in Tilted Position

made up by bolting together three 12-inch air brake cylinders. The cylinder should be located in a concrete pit below the floor level.

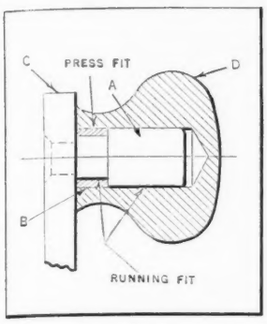
In Fig. 2 the stand is shown tipped at an angle. Before lowering the stand to bring the table into this position, the rod *C* is connected to the table and to the floor as shown. The locking pin *G*, which is employed to hold the table in place when in a horizontal position must, of course, be withdrawn before the table can be tilted. An air pump that is to be overhauled can be easily placed in position on the stand when it is tipped up as shown. The air pumps are wheeled up to the stand on an ordinary two-wheeled truck. After being placed on the stand, the pump is securely bolted down. The stand is then placed in a horizontal position by opening valve *B*.

for various sizes of pumps. These tables can be changed as required or the stand can be made with a solid top in which holes are drilled for fastening pumps of different sizes. The larger tables are made to fit over the smaller table.

An air pump stand of the kind described will be found a labor-saving device, as it enables the workmen to place the air pumps in the most convenient positions for making repairs and for overhauling. In addition to the tilting adjustment and the raising and lowering movement, the stand can also be revolved. From the viewpoint of safety, the stand is preferable to the loose block method of supporting the pumps while making repairs. The pump can be completely overhauled while mounted on the stand, including assembling, painting, and testing.

Portsmouth, Ohio J. H. HAHN

Shop and Drafting-room Kinks



Knob with Blind Stud Hole Assembled on Crank

ASSEMBLING KNOBS

In assembling knobs, handles, or small loose pulleys that must be free to rotate, it is sometimes desirable that the stud hole be drilled only part way through. A convenient method of assembling the parts under such conditions is shown in the accompanying illustration. In this case, the stud *A* and bushing *B* are assembled on the crank *C* first, after which the knob *D* is pressed on bushing *B*.

Rochester, N. Y. ERNEST C. ALLEN

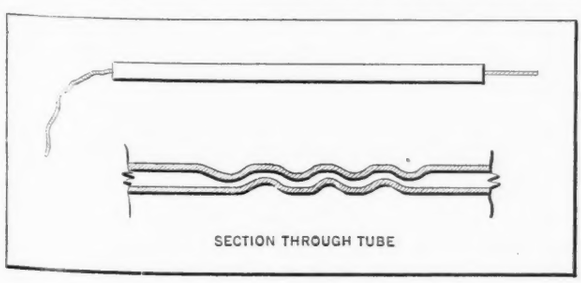
MAKING SQUARE HOLES IN BORING-BARS

To make a square hole in a boring-bar for the reception of square tool bits, first drill a hole the same diameter as the size bit to be used. Next grind the end of a new tool bit to a slight taper, so that it will enter the drilled hole. The bar should then be heated to a red heat and held on an anvil while an assistant drives the square tool bit through the hole. This operation raises the metal slightly at the edge of the hole, but this can be filed down smooth to conform with the radius of the bar. When cool, the bar is drilled and tapped at the end to receive a set-screw.

Syracuse, N. Y. H. L. WHEELER

SIMPLE WIRE STRAIGHTENING METHOD

The need for a rapid and convenient method of straightening wire often arises in a shop where a wire straightening machine is not available. One such method is to use a short scrap length of metal tubing having an inside diameter somewhat larger than the diameter of the wire. The wire is threaded through the tubing sufficiently far so that the end can be gripped. The tube is then dented or kinked in a series of kinks with a vise, hammer, or other means, the tube being rotated while so doing, so that the dents are spaced around the entire circumference, providing a path for the wire in many different directions, similar to that shown in the illustration. The wire pulled through this tube will emerge straight and true. The method is perfectly feasible and has been used for years.

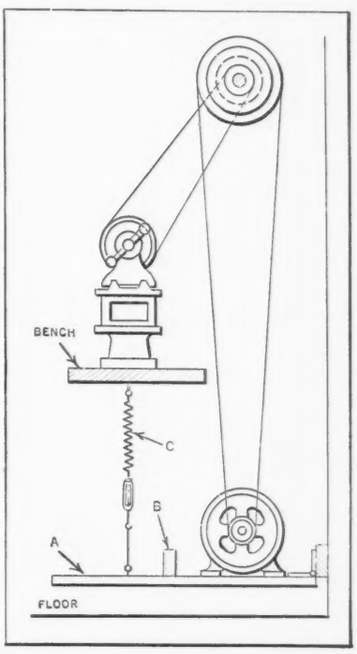


Method of Straightening Wire Rapidly without the Use of a Machine

Philadelphia, Pa. LEON J. LICHTENSTEIN

SIMPLE MOTOR DRIVE FOR BENCH LATHE

A simple and inexpensive driving arrangement for a small lathe, which has some advantages over the usual countershaft and belt-shipper method is shown diagrammatically in the accompanying illustration. The arrangement permits the motor to be started with no load. This feature is of value where the motor is operated from a heavily loaded lighting circuit, as it lessens the troublesome "winking" effect of the lights.



Treadle Control for Motor Drive to Bench Lathe

The motor is mounted on the foot-treadle *A*, which is attached by means of a hinge to a post at the rear of the bench. The other end of the treadle is nominally held against a stop *B* by the spring *C*. When the treadle is in this position, the belt from the motor to the countershaft is free and transmits no driving motion. To start the lathe, the operator simply depresses the foot-treadle with sufficient force to produce the necessary driving tension in the belt from the motor to the countershaft. All noise of running shafting ceases when pressure on the treadle is released. The motor also runs quieter supported as shown than when secured to a rigid member.

Everett, Mass. DEXTER W. ALLIS

COUNTERBORING WITH A TWIST DRILL

Having work to be counterbored and not having a counterbore of the specified size on hand, a drill was made to serve the purpose. First the hole was drilled to as near the required depth as possible with a regular drill. The same drill was then ground flat on the end, and used to complete the counterbore. This is a good kink to remember, as it permits rush work to be completed without delay when counterbores are not available but drills of the required size are at hand.

Stamford, Conn. JOSEPH E. ABBAZIA

Questions and Answers

COMPOSITION OF Y-ALLOY METAL

L. R. S.—What is the exact composition of the metal known as Y-Alloy, which I understand is used for pistons and cylinder heads of air-cooled airplane engines? What are its chief physical characteristics and machining properties?

This question is submitted to MACHINERY'S readers.

USE OF MACHINERY MAY BE CONSTRUED AS ACCEPTANCE

W. Y.—An engine was purchased with the right of trial by the buyer for a period of ten days. At the expiration of this time, the buyer gave the seller written notice of rejection, for the reason that the engine had proved unsuitable for the buyer's work. Following the giving of this notice, the buyer continued to use the engine, pending its removal by the seller. When the latter learned of this use of the engine by the buyer, after the expiration of the ten days, he refused to take the engine back and insisted that such use amounted to an acceptance. Was the seller within his rights?

Answered by Leslie Childs, Attorney at Law, Indianapolis, Ind.

On the facts as stated, it seems probable that the use of the engine by the buyer after rejection will be held to constitute an acceptance, and render the buyer liable for the price; at least this has been frequently held in many well reasoned decisions. For example, in one case the Court, in reasoning upon a situation of this kind, had this to say:

"The trial being complete, and the inadequacy of the article to fully satisfy the calls of the contract being established, the plaintiffs had the election to reject it altogether and rescind the sale, or, in certain business exigencies, to retain it as of some value, and pay such sum as might be proper after due allowance for its defects. In this situation, and with this right of choice, they made use of the engine for their own benefit for the remainder of the 27th and until noon of the 28th of August. There is no proof of any special exigency rendering such use unavoidable. Under authority of our decisions, such acts can have but one construction. They must be deemed to unambiguously declare plaintiffs' election to become owners." (133 Wis. 227).

STEEL ABRASIVES

M. C. R.—What are steel abrasives and what are they used for?

Answered by Charles Boultman, Manager, Supply Division, Pangborn Corporation, Hagerstown, Md.

Steel abrasives are small globules or particles of steel made by a method that gives them unusual hardness and toughness. These abrasives are used in a process similar to that of sand-blasting, the difference being that the steel particles are used to obtain the abrasive action instead of using sand.

Steel abrasives are first made into round globules or shot, by a blowing process. Each globule, after being blown to shape, is quenched, the rapid chilling causing it to assume a very close, dense structure. A subsequent heat-treatment reduces the chilling strains set up by the quenching, so that the shot or abrasive will resist impact and wear in a satisfactory manner.

Chilled shot, being round, is used when work can be cleaned by shock. The round globules act like numerous ball-peen hammers. The peening action gives satisfactory results in cleaning rough work, which is not subsequently to be enameled, galvanized, or plated.

For work which is to be subsequently treated by any one of the processes mentioned, what is known as angular steel grit is used. Angular grit is chilled shot broken down to produce sharp angular corners. The angular grit retains the original physical properties of hardness and toughness, but in blasting operations, it has the advantage of producing both impact and actual cutting action. It cuts like numerous sharp tools, actually removing minute chips from the surface being blasted and producing a matt finished appearance. The coarseness or fineness of the surface can be controlled by the size of the angular grit used. The fact that steel abrasive actually cuts, makes possible much more rapid production than with sand.

The crushing of shot to make angular grit is an expensive operation because of the rapid wear of the crushing tools. It is also impossible to control the sizes in the crushing, except in a very limited way, and a certain loss, therefore, results from pulverizing part of the crushed material into small unsalable sizes. This loss, together with the actual cost of the crushing operation, makes the cost of angular grit somewhat higher than that of globular shot. However, the higher cost is offset by its capacity for faster blasting production and cleaner work.

Steel abrasive, either in the form of shot or angular grit, can be used over and over again hundreds of times. It is superior to sand in that it does not break down like sand does, and one ton of steel abrasive will do the work of a carload of the very best sand-blast sand. In a general way, it may be stated that the relative ultimate cost, based on work produced by steel abrasive as compared with sand-blast sand, is only about from one-quarter to one-half of the latter.

The nozzles of the blast also last from two to four times longer with steel abrasives than with sand. The slower wear of the orifice also effects a big saving in compressed air. The dust due to ordinary sand-blasting is practically absent, as there is no dust from the metal abrasives themselves. A tremendous amount of storage space is saved, as compared with that needed for sand, and the handling charge is much reduced; in fact, compared with sand, it is almost negligible.

Arc-welding Steel Structures and Machine Parts

By A. M. CANDY, Welding Engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

WITHIN the last few years we have witnessed a great change in the attitude of engineers and architects toward the use of the arc-welding process as a means of fabricating steel structures and building machinery by the use of rolled steel instead of castings. This change has taken place because of the numerous examples of successful work that has been accomplished along these lines, and the dissemination of data on the strength of welds. As a result, very few large plants are now without arc-welding equipment.

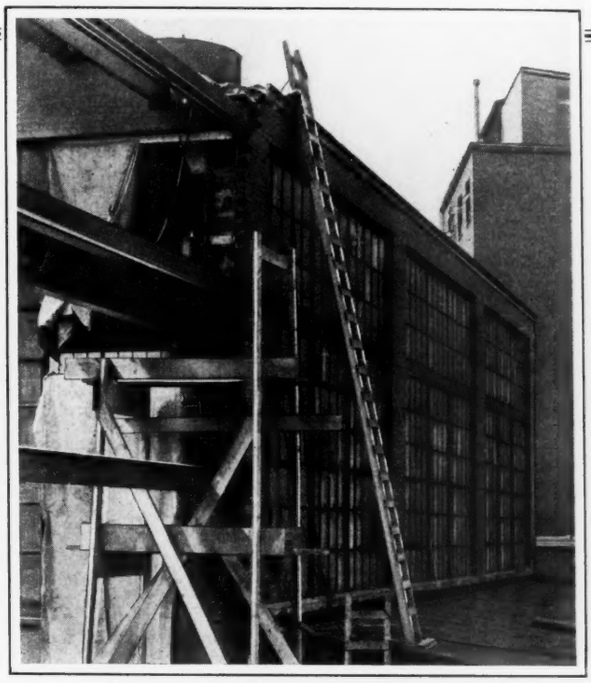


Fig. 1. Arc-welding Makes it Unnecessary to Tear Away Much of the Masonry to Make Connections in Constructing Additions to Steel Structures

One of the most profitable sources of saving by means of this equipment is in plant maintenance, where changes in existing structures are required or where additions to buildings become necessary. The arc-welding process makes the "steel carpenter" available to the same extent that regular carpenters have been available in the past for working on wood frame structures. When a wood frame building was to be constructed or changes were to be made in such a structure, general plans were made and a bill of material ordered. The carpenters cut the material to the proper length and nailed the members together. With the advent of riveted steel construction, all material and connections were laid out so that lengths and punched holes would line up for assembly. When work of this type was required for changes in an existing building, it was often difficult to locate the original designs, and even more difficult to make measurements of the structure to enable the draftsman to make new lay-outs for the additions. This resulted in costly delays.

The arc-welding and cutting process has reduced the amount of detail drawing to the minimum, because the steel can be ordered and sent directly to the job, cut up, and welded in place as needed, by carpenters that have been trained to do arc-welding work. In fact, these "steel carpenters" are better off than their brother "wood carpenters," because if the former should accidentally cut off a piece too short, another piece could be welded on. This is exactly the way additions were made to a laboratory building and a pent house for an elevator at one of the Westinghouse plants. The executive in charge of the work estimated that about 35 per cent of the drawing-room work was saved by eliminating detailing; and from 10 to 20 per cent of the cost of the complete job was saved.

In the same plant, crane runways have been extended along aisles where no provision had been previously made in the columns for this service. The columns were stiffened by welding heavy plates to the faces and welding brackets to the columns for carrying the crane rail girders. In the case of additions to existing structures, not only are savings made by constructing the building by welding, but savings are also made where the addition joins the main structure, owing to the relatively small amount of brickwork that has to be removed

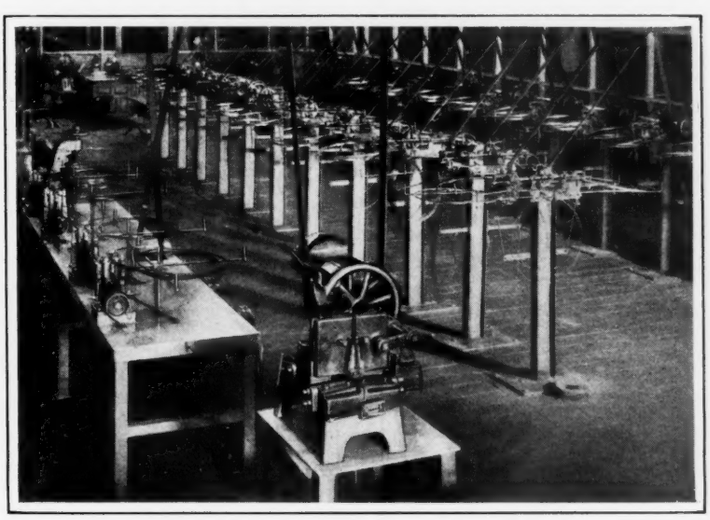


Fig. 2. Benches and Stands in Saw Sharpening Department Made by Arc-welding

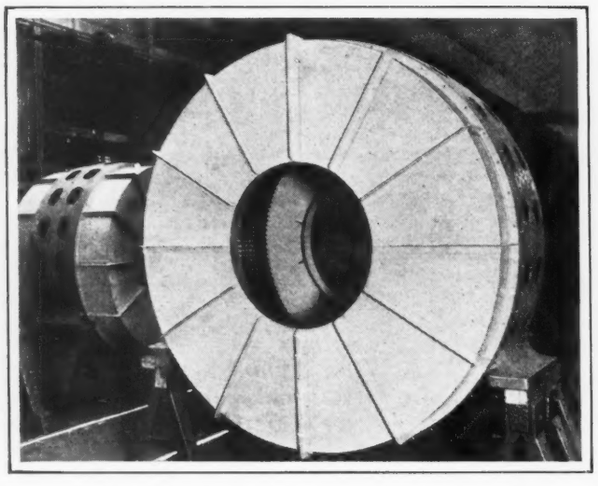


Fig. 3. Arc-welded Generator and Motor End Bells

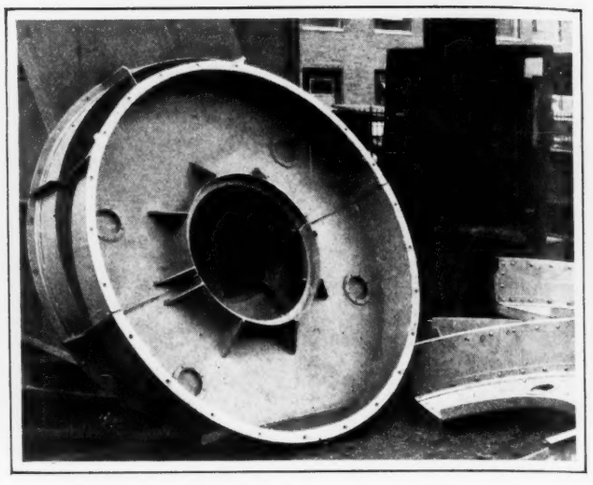


Fig. 4. Generator End Bells Constructed by Arc-welding

in order to permit the new beam ends to be welded to the column faces. This is shown by Fig. 1.

The view in the saw filing department, Fig. 2, shows benches, tables, and racks, all constructed of arc-welded rolled steel. These devices are rigid, present a neat appearance, are lighter in weight, and cost somewhat less than those formerly used. The same construction is being extended rapidly to racks and bins for the storage of finished products, tools, and raw materials, and to lockers and cabinets.

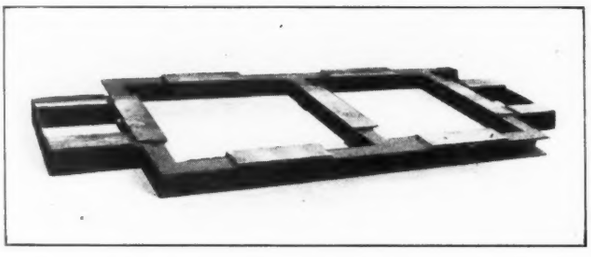


Fig. 5. Generator-set Bedplate Made by Arc-welding Rolled-steel Shapes and Plates

In the field of manufacturing machinery, large savings in weight are being made by substituting arc-welded construction, not only for riveted construction but also for iron and steel castings. Figs. 3 and 4 show a line of generator and motor end bells which have been redesigned for arc-welded construction. The welded end bells are more rigid, neater in appearance, and lighter in weight, due to the elimination of considerable angle material that was required when these parts were constructed by means of riveting.

Bedplates for generators, motors, and sets are now being constructed of rolled steel shapes and plates, one of which is shown in Fig. 5, in place of the former cast-iron designs. This construction has in some cases reduced the weight by 50 per cent, and eliminated patterns and pattern storage. This form of construction is also being rapidly applied to the construction of motor frames, rotors, and frames for large turbines, generators, etc., as shown by Figs. 6 and 7. It is the author's belief that this method of construction wll be largely adopted in the future by machinery manufacturers.

* * *

Safety on the railroads has increased considerably during the last ten years. The number of fatal accidents to railroad passengers in 1927 was only 91, or one for each 9,100,000 carried. The best previous record was one for each 7,216,000 carried.

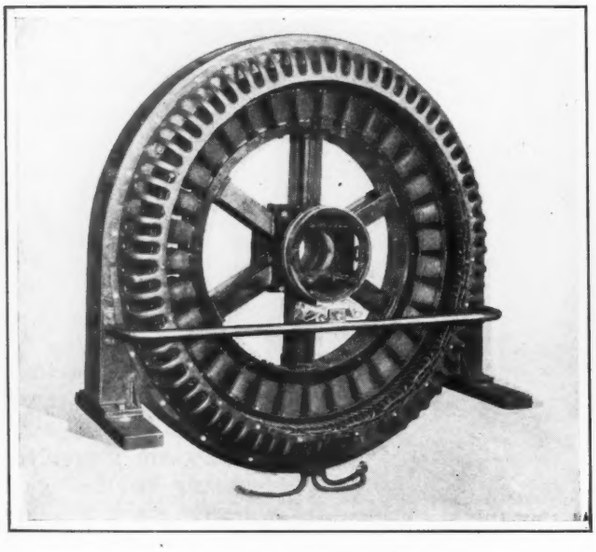


Fig. 6. Arc-welded Rotor and Frame

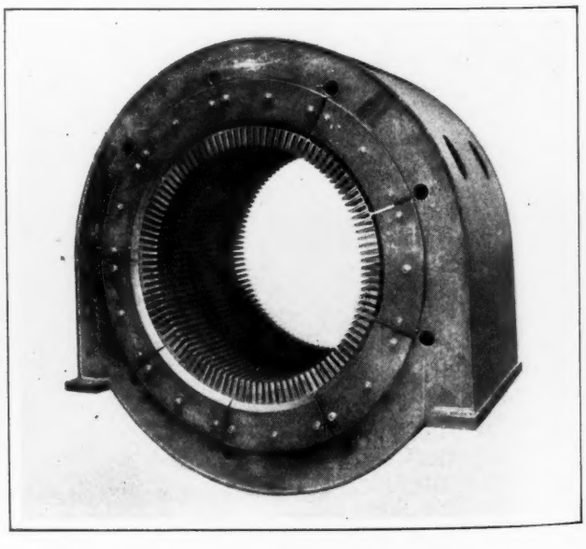
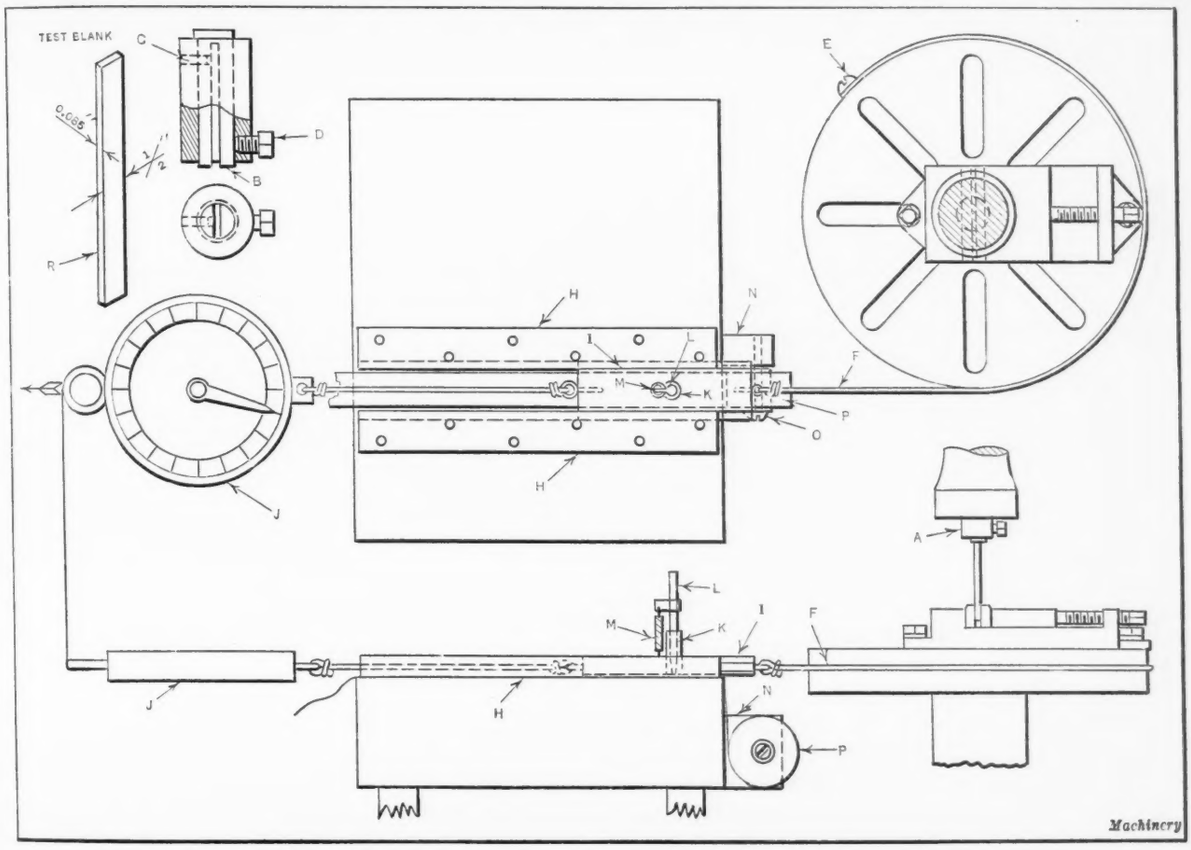


Fig. 7. Motor Frame Constructed by Arc-welding

IMPROVISED TORSION TESTING APPARATUS

By HENRY SIMON

The improvised apparatus illustrated in this article was used in testing material for screwdriver blades, and also for testing the finished blades. These blades were for a pocket magazine tool, and the requirements were that they be of exceptional strength for their weight and size. The dimensions were fixed before the work was started, but the kind of material, the heat-treatment, and also the taper of the point were things that were yet to be decided upon and that were beyond being established with any degree of satisfaction by such obvious methods as holding the blades in a vise and applying a wrench to the other end.



Apparatus for Testing Torsional Strength of Screwdriver Blades

The equipment illustrated, which shows the actual lay-out used on several occasions, with some minor changes suggested by experience, performed the work in a very creditable manner. It furnished conclusive evidence, which could be relied upon as being correct within a few per cent, in regard to the two separate factors sought—namely the ultimate strength of the blade, and its resistance to torsion—under conditions closely approximating actual use.

Something like a dozen different steels were to be tried out, and as each of these was to be tested at three or four drawing temperatures differing by about 10 degrees, and as the ideal length of the tempering bath was to be established, it became evident that several hundred blades would have to be tested. This was done rapidly and at small expense in the manner to be described, the cost of rigging up the apparatus on a drilling machine and making the few parts required being about $15.

The chuck is fitted with a special bushing *A*, designed to clamp the upper end of the sample, and consists of an outer tubular piece of cold-rolled steel in which a hardened plug *B* is an easy fit. Plug *B* is slotted centrally about 0.010 inch wider than the thickness of the stock to be tested, and is held against turning and sliding by a pin *C*, while a set-screw *D* allows the lower end to be firmly clamped upon the test piece. The drill spindle is clamped tight at the desired height, while the table is allowed to rotate freely.

On the drill table, a vise is clamped under the spindle, and at the proper point on the periphery, a small hole is tapped for a screw *E*, which holds one end of a pull wire *F*, secured to piece *I* on a board fitted to the top of a shop truck from which the casters have been removed. This truck is weighted down, and the drill table adjusted to whatever height is required. Two grooved wooden pieces *H* are nailed to the truck top a distance apart to allow a free running fit for the double-tongued piece *I*, which is connected with the pull wire from the drill table and similarly connected to a spring scale *J* at the opposite end. Piece *I* is pierced by a short tube *K*, which makes a free fit for the mechanical pencil *L*, the pencil being held down with a constant tension by means of a small coil spring *M* attached to the sliding piece *I* and to a clip on the pencil.

A block *N*, nailed to one side and under the channel formed by the two pieces *H*, receives a screw *O* upon which is mounted a roll *P* of standard adding machine paper, which is passed along the channel, there being a space of about 1/16

inch between the bottom of block *I* and the top of the table.

In use, the paper is run out until it covers the length that will be traversed by the pencil, and held at the roll end by giving the screw in the roll a turn, or by the fingers. The test piece is clamped, the pencil lifted away from the paper, and an initial tension equal to a predetermined amount, say 1 pound, put upon the wire by pulling on the scale. The pencil is then released, and the spring scale slowly and steadily pulled up to the desired point; in some cases, this will be the breaking point, and in others, the point at which permanent deformation of the sample is observed. In either case, the pencil will register deformation or shear by a clearly defined graph. In the case of the breaking test, the break will be perceptible by the changed appearance of the pencil line under the accelerated motion of the pencil. As each graph is made, the paper is pulled out, the number of pounds and any other necessary information written under the line, and the strip cut off against the back edge of the channel.

Blanks such as shown in the illustration at *R* were used in the first series of experiments, the blanks being ground to within limits of 0.001 inch on the thickness and width. In testing finished blades, a block of tool steel, slotted similar to a screw and in such a way as to allow the blade point to enter to the required depth, is clamped in the vise. Various definite pressures on the point can be obtained by engaging the lever arm of the drill press and weighting it, or, for the lighter points, by removing some of the weight by partially supporting it with a coil spring.

It is best to have two men at hand in using the equipment—one to change blades and arrest the movement of the table after the break occurs, and the other to operate and read the scale and note down the readings. From fifty to seventy-five pieces per hour can be easily tested.

* * *

SEVENTY-FIFTH ANNIVERSARY OF THE BAUSCH & LOMB OPTICAL CO.

The Bausch & Lomb Optical Co., of Rochester, N. Y., is celebrating the seventy-fifth anniversary of the founding of the company this year. The story of this company is one of early struggle and success achieved in spite of many obstacles.

In Southern Germany more than three-quarters of a century ago John Jacob Bausch received his early training as an optician. After several unsuccessful attempts to establish himself as an optician, both in his own country and America, he found employment as a wood turner in Rochester, N. Y., in 1838. He worked at this trade until 1852, when his hand was injured in a buzz saw. It was during the weeks of inactivity following this accident that his friendship with Henry Lomb ripened, which resulted later in a partnership between the two men.

With sixty dollars, lent to him by Henry Lomb, John Jacob Bausch set up a small optician's shop in Rochester in 1853. The business was organized as a partnership between Mr. Bausch and Mr. Lomb, but Mr. Bausch had entire charge, as Mr. Lomb had volunteered to serve in the Army at the outbreak of the Civil War. It was during the period of the Civil War that Mr. Bausch happened to pick up a piece of hard rubber on the street, and from this conceived the idea of making optical goods and frames from this material. His work along these lines was so successful that in 1863, when Henry Lomb returned from the War, he had wiped out all the debts of the partnership and had a bank balance of $800.

The next year the business, which was then operating under the name of the Vulcanic Optical Instrument Co., moved into larger quarters, and an office was opened in New York by Henry Lomb. Because the expanding manufacturing business involved so much of their time, the partners sold their retail business to E. E. Bausch. Four years later John Jacob Bausch invented and applied the first nosepiece to an eye-glass. At this time the company erected its own factory on the present site of the Bausch & Lomb Optical Co. at St. Paul and Vincent, now Smith St. This property was purchased by the company now doing business under the name of the Bausch & Lomb Optical Co.

In 1875, the company began the manufacture of microscopes. A year later, the model which it had created was exhibited at the Centennial Exhibition in Philadelphia and created a very favorable impression among the scientific men who examined it. It was not until 1890, however, that the Bausch & Lomb Optical Co. began to bring in real financial returns. In this year, also, it became associated with the Carl Zeiss Optical Co. in Jena, Germany.

The Bausch & Lomb Optical Co. was the first company to manufacture practical commercial anastigmat photographic lenses. The next year the company started the manufacture of stereo prism binoculars. More floor space was obtained by the addition of a story on the first factory building. This year also the Bausch & Lomb microscope won a prize at the International Exposition Universelle in Paris.

In 1903, William Bausch made some experiments in the manufacture of optical glass, which up to this time had been obtained only in Europe. His early experiments were not satisfactory, but the year 1915 saw the successful termination of a series of experiments in the manufacture of optical glass. This was of considerable importance to America three years later, when the firm was able to offer the Government an excellent quality of optical glass manufactured in its own plant, in view of the fact that the war cut off the foreign supply, and the Bausch & Lomb Optical Co. was then in a position to manufacture range finders, binoculars, telescopes, and many other optical instruments for military purposes.

On February 14, 1926, John Jacob Bausch died at his residence in Rochester. He outlived his partner, Henry Lomb, who died at his home in Pittsford eighteen years before.

The Bausch & Lomb Optical Co. attributes the secret of its present success and of the service it has given to the world to the principles of quality, carefulness in manufacture, and skill which John Jacob Bausch and Henry Lomb instilled into this organization from the very first.

HEAT-TREATING LARGE GEAR RINGS AUTOMATICALLY

Flywheel starter-gear rings ranging from 12 to 16 inches inside diameter are carried automatically through a gas furnace, both in normalizing and hardening processes, at the Automotive Gear Works, Inc., Richmond, Ind. The normalizing process is performed on the rough rings prior to any machining operation, while the hardening is carried out after the rings have been machined all over and the teeth cut. The rough rings are produced from S.A.E. 1050 steel bars, 17 to 28 feet long, which are rolled into coils having five or six turns. These coils are then sawed lengthwise to produce five or six distinct rings, the ends of which are butt-welded together, after which they are ready for the normalizing process.

From the illustration, it will be seen that the furnace is equipped with a long conveyor screw which runs the full length of the furnace and extends for a considerable distance at the loading end. The screw extension is a steel casting, while the screw portion within the furnace is made of "Nichrome." Parts placed on the screw extension are automatically carried through the furnace as the screw rotates. A variable-speed motor is provided to drive the screw, so that its speed of rotation may be varied to suit the work. This motor is also reversible. From 120 to 140 rings are generally run through the furnace per hour in hardening operations, and from 100 to 125, in normalizing operations. The heating chamber of the furnace is about 8 feet long. For hardening operations, the furnace is maintained at a temperature of about 1525 degrees F., and for normalizing, at about 1535 degrees F.

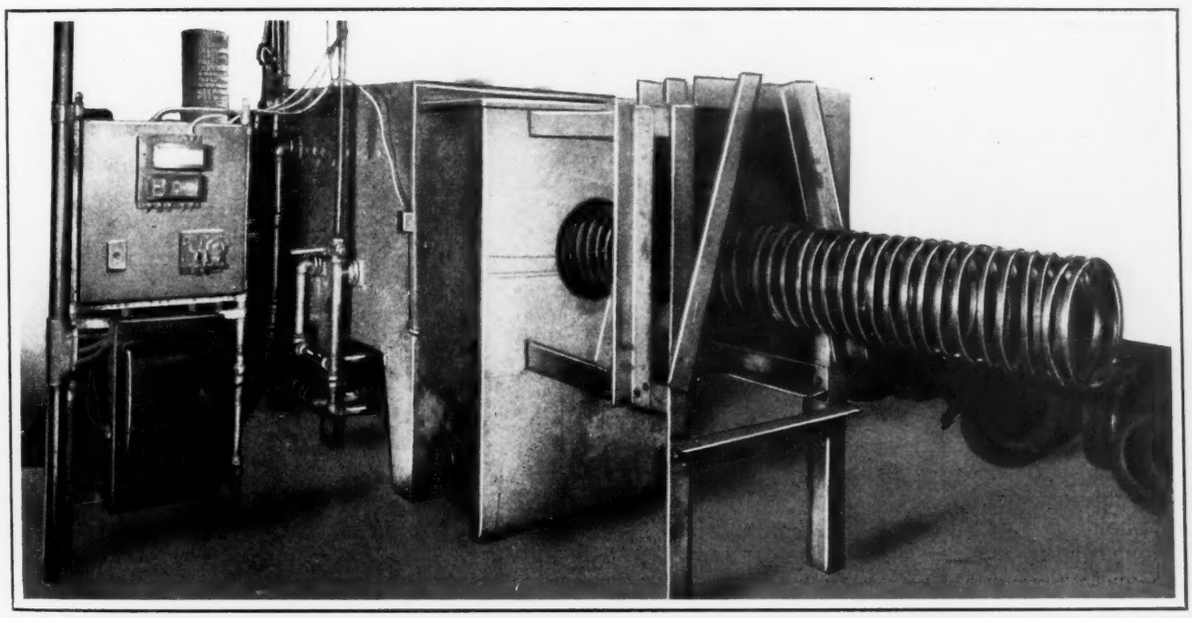
In hardening operations, as the gear rings reach the far end of the conveyor screw, they automatically drop on a chute, down which they slide to an oil quenching tank beneath the floor. This chute is sealed to prevent air from coming in contact with the gears at this stage in the hardening process. When normalized rough forgings are being run through the furnace, the chute is arranged to deliver the rings to the operator of a hydraulic press. In this press, each blank is sized, straightened, and shaped, ready for the machining operations.

A unique construction is resorted to for supporting the conveyor screw. At several places, as at the angle-iron structure in front of the furnace, the thread of the conveyor screw is enlarged to about 18 inches in diameter. Rolls running in contact with these enlarged threads, serve to support the screw. Obviously, the gear rings can pass these enlarged thread portions, since the inside diameter of the rings is considerably greater than one-half the diameter of the threads and since the groove of the screw on which the rings rest does not increase in diameter.

* * *

CANADIAN EXPLORATION BY AIRPLANE

Upper Canada is fast emerging from the unmapped and undeveloped wilderness state through the instrumentality of the airplane, according to A. M Narraway, of the Topographical Survey of Canada, who told, in an address at the summer meeting of the Society of Automotive Engineers in Quebec, how the enormous natural resources are being brought to light and made more accessible in the undeveloped four-fifths of the Dominion by means of the airplane.



Furnace Arranged for Automatically Carrying Large Gear Rings through Normalizing and Hardening Operations

* * *

The Bureau of Standards, Washington, D. C., has started the publication of a new monthly periodical known as the "Bureau of Standards Journal of Research," which will continue the publication of the two series of research papers heretofore issued under the headings "Scientific Papers" and "Technologic Papers." The new journal will contain the Bureau's research papers and critical reviews in the fields of science and technology. Yearly subscriptions at $2.75 may be sent to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Hollow-milling and Drilling Jigs for Turbine Governor Links

By J. E. FENNO

THE jigs shown in Figs. 1 and 3 are used in hollow-milling the trunnions *A* and drilling the angular holes *B*, respectively, of brass turbine governor links like the one shown in Fig. 2. Originally, the trunnions of these links consisted of a brass rod pressed into place in the cast-brass body. In order to cut down the material and production cost, it was decided to cast the entire link solid and machine the trunnions with a hollow mill.

The jigs illustrated and described were designed to meet the requirements of the new production methods, and have already paid for their construction many times over. The first operation on the links, which consists of facing the bosses at each end, is performed on a milling machine, using angular cutters and a work-holding vise equipped with special jaws. This operation requires only two cuts, and is not illustrated.

The second operation, that of hollow-milling the trunnions, is performed on a two-spindle drilling machine using the jig shown in Fig. 1. The work is located on the pad surface *N* by the six pins *E*, and clamped in place by straps *D*. The screws that tighten the straps on the work are provided with handles *H*, thus eliminating the necessity for using a wrench. Elongated slots in straps *D* permit these members to be slid outward for loading and removing the work.

The jig is lined up under the machine spindles by shoulder pins *I*, which are a sliding fit in the machine table, and two stop-pins in the table (not shown). One stop-pin locates the jig under the spindle carrying the roughing hollow mill, and the other stop lines the jig up with the spindle carrying the hollow mill for the finishing cut. After taking a roughing cut on one trunnion, the jig is slid along the table into position for the finishing cut.

The aligning plug *P*, having a hole in its end which is a close fit over the finished trunnion, and a body which is a close sliding fit in the guide bushing *R*, is next put in place and the jig turned upside down as shown. The plug *P* is not used when rough- and finish-milling the first trunnion, but serves to keep the finished trunnion in line with the cutters when taking the roughing and finishing cuts on the other trunnion. After finishing both trunnions, the jig is again turned upside down, plug *P* withdrawn, and the work removed. A bayonet slot with an inclined surface which is forced against the under side of the shoulder screw *O* by a clockwise motion, serves to secure the aligning plug *P* in place.

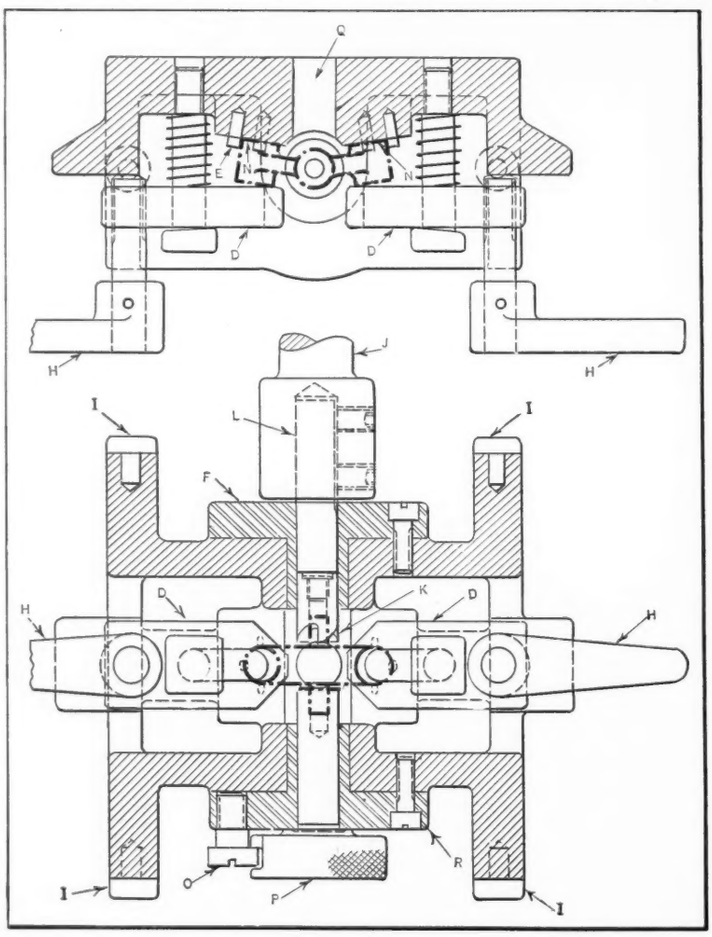


Fig. 1. Fixture Used in Hollow-milling Trunnions of Piece Shown in Fig. 2

The hollow mill *K* is screwed on its shank *L*, concentricity being insured by a shoulder on the shank fitting into the concentric recess in the upper end of the cutter. These cutters are comparatively inexpensive to make, and are easily replaced. The downward movement of the spindle is stopped by the end of the holder *J* coming in contact with the top face of the guide bushing *F*. An arbor inserted through the reamed hole *Q* is used in setting up the jig, the hollow mill being lowered until it touches the arbor and the holder *J* being brought down and held in contact with the guide bushing while the two set-screws shown in the illustration are tightened on shank *L*. This insures correct location of the finished shoulder or face at the base of the trunnion.

After the trunnions are finished, the angular holes *B*, Fig. 2, are drilled on a vertical-spindle drilling machine equipped with the dial feed jig shown in Fig. 3 and a two-spindle drilling head. The drills are guided by bushings *A* and *B*. The dial *C* has four work-holding members *D*, and is indexed one-quarter revolution after each drilling movement. The work is dropped into the holding members *D* in the loading position, the trunnions fitting into U-shaped slots *E*, as shown in section *Y–Y*.

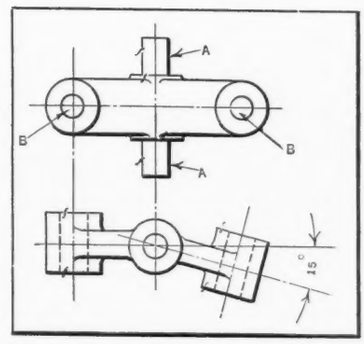


Fig. 2. Turbine Governor Link

The dial is indexed to bring the first piece in line with bushing *A* and drill *M*, and the first hole is then drilled. The next indexing movement brings the other end of the piece under bushing *B* and drill *N*. The second drilling movement completes one piece and drills the first hole in the second piece. After the next indexing movement, the finished piece is removed and replaced by a new piece of work. This cycle of operations is repeated, one piece being completed at each feeding movement.

Referring to section *Y–Y*, it will be noted that the work-holding members *D* are pivoted on studs *F* and that the projecting lugs *G* rest on the rings *H*, having a cam surface or drop, as indicated by the elevation section *X–X*. When the work is indexed from the position under drill bushing *A* to the position under bushing *B*, the lug *G*, riding down the cam surface or ring cast on the base, allows the holder to pivot on stud *F*, so that the axis of boss *J* will be in a vertical position ready for drilling when indexed to the drilling position under bushing *B*. A rise in the cam ring at *P* serves to raise the new piece of work placed on the holder into the proper position for drilling the first hole. The dial *C* is locked in position by pin *K* attached to the drilling head, which enters one of the four indexing holes *L* before the drills enter the work.

* * *

The largest electrically driven passenger vessel in the world, the *Virginia*, was recently launched at the Newport News Shipbuilding and Dry Dock Co.'s shipyard. This vessel is of twin-screw design, each propeller being driven directly by an 8500-horsepower General Electric motor. Electricity is generated by steam-turbine-driven generators.

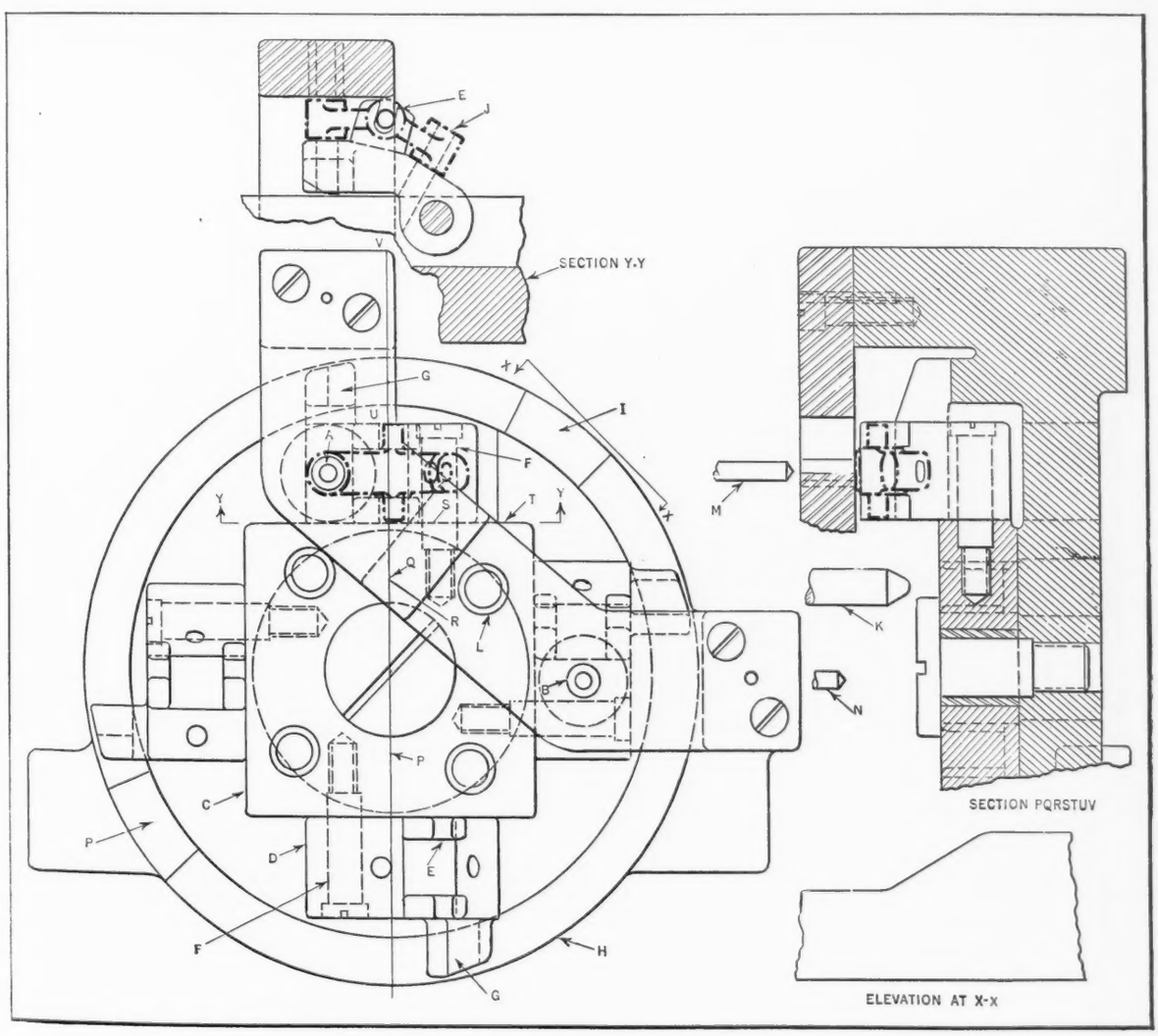


Fig. 3. Four-position Dial Drill Jig Employed for Drilling Holes in Governor Links

Special Tools for Railway Shops

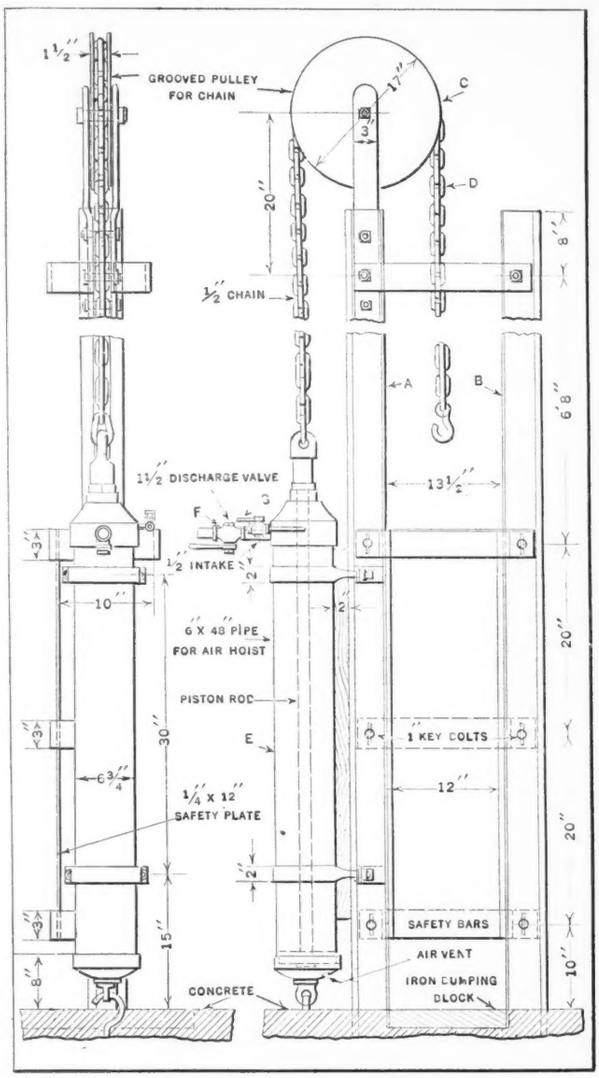
BUMPING DEVICE FOR SHORTENING LOCOMOTIVE DRAW-BARS

By HARRY M. WILSON, General Foreman, Atchison, Topeka and Santa Fe Railway

When too much play develops between an engine and its tank as a result of wear or elongation of the draw-bar, the latter member is subjected to a shortening operation known as "bumping." In small shops, this is generally accomplished by heating the bar and then raising it and allowing it to fall endwise on an iron block.

In the accompanying illustration, is shown an air-operated bumping device for raising and releasing the heated bar. This device can be operated by the blacksmith and his helper, thus making it unnecessary to employ the services of several men for raising the draw-bar. It can be readily constructed from scrap material found in almost every roundhouse. Two scrapped rails *A* and *B*, set in a bed of concrete 3 feet deep, serve as a support for the pulley *C* over which the hoisting chain *D* passes. One end of the chain is secured to the piston of the air cylinder *E*, and a hook is provided at the other end which can be hooked into the hole in one end of the draw-bar.

After the draw-bar has been heated to the required temperature, the chain is attached and valve *G* opened, admitting air to the upper end of cylinder *E*. When the descending piston has raised the bar to the required height, the air is shut off and the cut-out valve *F* opened. This allows the draw-bar to drop suddenly. The lower end of the bar hits the iron bumping block set in the concrete foundation with considerable force, causing the bar to be shortened. This operation is, of course, repeated as many times as may be necessary to shorten the draw-bar the amount required to take up the play between the engine and its tank.



Pneumatically Operated Hoist and Bumping Block for Shortening Draw-bars

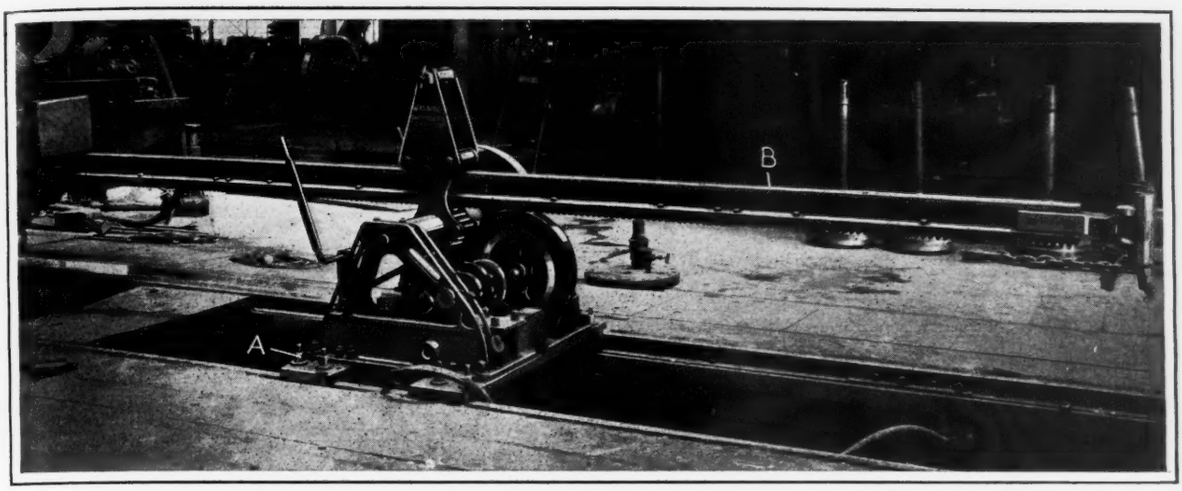
PNEUMATICALLY OPERATED LOCOMOTIVE MOVING DEVICE

By J. B. IRWIN, Shop Superintendent, Chicago, Burlington & Quincy Railroad Co.

The pneumatically operated locomotive moving device shown in the accompanying illustration was designed by the writer to eliminate the necessity of using a switch engine in the shop for moving a locomotive when "spotting" or shifting. It has proved invaluable in testing or measuring piston clearances at the ends of the stroke, setting valves, making spring rigging changes, applying side-rods before the locomotive is wheeled, and for handling any other work that necessitates moving the locomotive.

One of the advantages of the device is that it eliminates the necessity of using valve setting rollers or moving the locomotive by means of pinch bars when setting the valves. This enables the required adjustments to be made while the main rods and all other parts are in their normal running positions. The device is moved about the shop by means of the overhead crane. Clamps which slide underneath the ball of the rails can be secured in place by bolts *A* employed to hold the moving device in place. The beam *B* is equipped with a standard coupler at one end and a suitable fixture for coupling into the rear end of a locomotive at the other end.

The machine shown in the illustration (on which a patent has been applied for) is operated by a five-horsepower air motor, and is capable of exerting sufficient force to move the heaviest locomotive and tender in either direction. The rate of movement is approximately 20 feet in 1 1/2 minutes. Movements as fine as 1/16 inch may be readily obtained when desired. The design of the machine base and the gear-driving arrangement is shown in the illustration. The device is said to save at least one shop day on each locomotive overhauled.



Pneumatically Operated Device for Moving Locomotives in Repair or Construction Shops

PRESS FOR PISTON-VALVE BUSHINGS

By J. D. STEWART, Plant Engineer, Atlantic Coast Line Railroad Co.

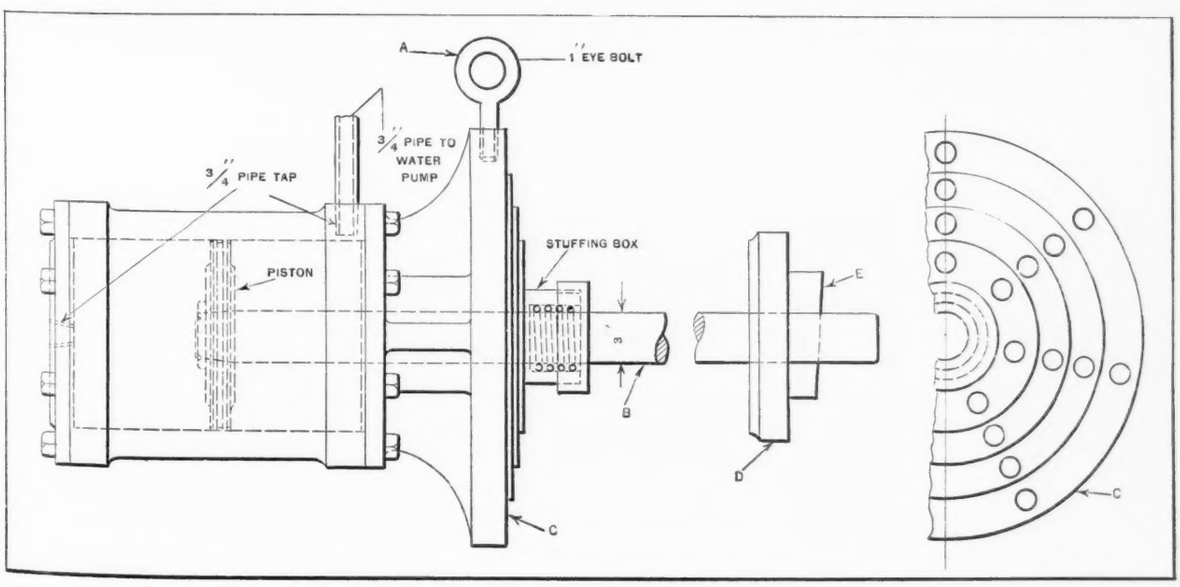
A portable hydraulic press for pulling locomotive piston-valve bushings into place is shown in the accompanying illustration. With this press suspended from an overhead crane, the average time required for applying a valve bushing, under favorable conditions, is thirty minutes, whereas the best time obtainable with the old screw type press was from two to three hours. The hydraulic press will also pull in a tighter fitting bushing than the screw press formerly used.

The general construction of the press is shown by the illustration. The eyebolt *A*, which facilitates handling the press with an overhead crane, is located as nearly as possible at the balancing point. When ready to pull in a bushing, the piston-rod *B* is put through the valve cylinder, and the faceplate *C* is placed over the valve cylinder head studs. The bushing is then placed in position, with the pulling plate *D* back of it and the key *E* in its slot.

Next, water is pumped into the cylinder, which is 10 inches in diameter and has a stroke of 12 inches. The pump employed in the boiler department for hydrostatic tests is used for this purpose. The pulling force thus obtained is sufficient to draw in any properly fitted bushing. After the bushing has been pulled in, air is admitted to the head end of the cylinder to force the piston back to the front end and expel the water. Shoulders of various diameters on the faceplate serve to center or line up the bushing press with the axis of the valve bore. Holes are also drilled in the various steps on the faceplate to suit the spacing of the valve head studs.

* * *

Scholarships distributed annually by the Westinghouse Electric & Mfg. Co., providing for annual payments of $500 each to be applied toward a four-year engineering education in any technical school or college that the winner selects, have been awarded to four young men, three of whom are sons of employes of the Westinghouse company, and one an apprentice at the Bloomfield Works of the Westinghouse Lamp Co. Since the establishment of the fund in 1919, thirty-six scholarships have been awarded, and as each covers four years, there are always sixteen young men receiving benefits from the awards.



Portable Press for Piston-valve Bushings

The British Metal-working Industries

From MACHINERY's Special Correspondent

August 15, 1928

DURING the past month there has been little change in the situation as a whole existing in the British metal-working industries. Last month attention was drawn to the plight of the railways, and it is encouraging to note that the companies and employes have now come to an agreement whereby all wages and salaries, including the remuneration of directors, will be reduced by 2 1/2 per cent. The agreement is to be terminable at any time after the expiration of a year, by three months' notice on either side. The economies thus effected will undoubtedly substantially improve the position.

The Machine Tool Industry is Better Employed than it has been for Many Months

In the Birmingham district, there are few machine tool makers who are not fully employed. The automobile industry is an important customer, but there is a good general business besides, and a growing demand for the heavier types of machine tools. The representative of an important group of machine tool makers has recently returned from Russia and speaks of excellent prospects in that quarter.

In Yorkshire, there is a good volume of work passing through the machine tool shops, and those firms that are showing at the forthcoming exhibition at Olympia are working at high pressure to keep pace with orders in hand, and at the same time push ahead the machines to be exhibited.

Reports from other districts, if not quite so satisfactory, indicate that, as a whole, the machine tool industry is better employed than has been the case for many months, and with the increased buying that will certainly follow the Olympia Exhibition, excellent prospects for the autumn are assured.

Little Change is Noted in Overseas Trade

During June, 1116 tons of machine tools were exported, this total being slightly above the May figure of 1081 tons, but still substantially below the April total of 1530 tons. Imports during June showed little change compared with May, the totals for the two months being 516 and 510 tons, respectively.

While the value of exports fell from £156,680 in April to £146,429 in May and further to £126,900 in June, the value of imports after falling from £108,649 in April to £87,760 in May, rose to £97,084 in June. The ton value of exports fell from £135 in May to £114 in June, while the ton value of imports has risen steadily from £160 in April to £172 in May and to £188 in June. The latter figure has only twice been exceeded during the past year.

Exports of tools and cutters in June were valued at £56,834 as compared with £56,669 in May and £48,675 in April. Considering the half-year as a whole, two divergent tendencies are noted. Exports that were depressed during 1925-1927 are now recovering to the 1921-1924 level, but are still 4 per cent behind. Imports, on the other hand, have increased by more than 125 per cent, and the rise has been maintained for three years.

Production of Iron and Steel Falls

There were 141 furnaces in blast at the end of June, a net decrease of 7 since the beginning of the month. The production of pig iron during June amounted to 563,700 tons, compared with 591,500 tons in May and 651,300 tons in June, 1927. During the first half of the present year, pig iron production totalled 3,422,200 tons, compared with 3,728,000 tons during the corresponding period last year.

During June, steel production fell considerably, amounting to 709,000 tons, compared with 752,700 tons in May. The total output for the half year amounted to 4,289,700 tons, compared with 4,989,100 tons in 1927.

Second-hand Cars Obstruct New Business in the Automobile Industry

Regarded as a whole, the season has been a disappointing one to the automobile industry, and this fact is chiefly attributed to the large number of second-hand cars on the market, which prove a great obstacle to new business. This problem is one that is becoming more serious every year. The effect of second-hand cars is felt principally in the light car trade, and in the case of more powerful and expensive cars is much less pronounced.

Despite depressed trade conditions this year, there are very few manufacturers who are not making arrangements for an increased output in 1927.

Shipbuilding Yards Continue to Show Activity

Lloyd's Register of Shipping Statistics, showing the vessels under construction at the end of June in Great Britain and Ireland, gives a total of 1,202,610 tons. This figure is about 238,000 tons less than the total building at the end of March, and some 188,000 tons lower than the total at the end of June, 1927.

Of the total tonnage building in the world, motor ships exceed steamships by 362,000 tons. But whereas in other countries motor ships account for 953,718 tons, as compared with 488,981 tons of steam-driven vessels, the tonnage of motor vessels under construction in British yards is only 546,826, a figure that is considerably less than the tonnage of steamers building. The increasing use of internal combustion engines is further indicated by the fact that while there are now building in the world 65 motor ships, each of 8000 tons and upward, only 21 steamers of a similar tonnage are under construction.

"Gunite"—its Properties and Applications

ENGINEERS who experience difficulty in getting cast iron or steel to satisfactorily fulfill severe service requirements on machine members will be interested in a new metal known as "Gunite," recently announced to the trade by the Gunite Corporation of Rockford, Ill. In chemical composition, this metal is of such a nature that it lies about midway between a cast iron and a true steel. No metallic constituents are added, so "Gunite" is not an alloy. It can be hardened to 477 Brinell, which is better than "file hard," when heated to 1600 degrees F. and quenched in oil or water, and is capable of being annealed. Before heat-treating, its average hardness is around 180 Brinell, this hardness being due to toughness. The metal does not exhibit the ductility of malleable iron or steel, and the shrinkage is less than one part in one thousand as a result of heat-treatment.

Fig. 1. Micrograph of Cast Iron, 750 Diameters Magnification. Note the Large Areas of Graphite, Ferrite, Pearlite, and Cementite

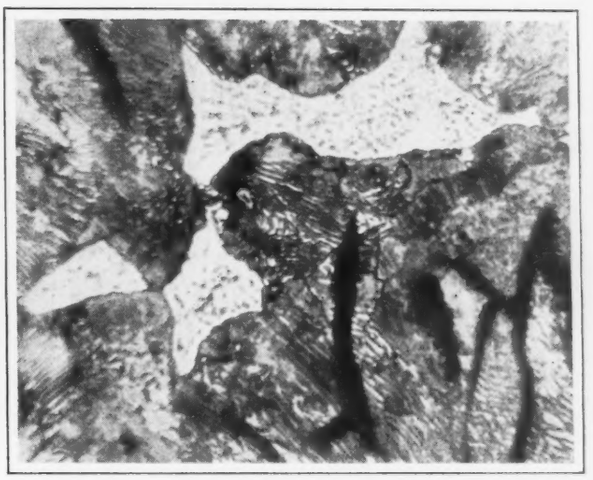


Fig. 2. Micrograph of Semi-steel, 750 Diameters Magnification. This Structure is Similar to Cast Iron with the Ferrite Eliminated

Among the desirable properties of "Gunite" the following may be mentioned: "Gunite" castings show practically no tendency to distort during the process of machining. The metal has an exceptionally high resistance to deflection under compression or bending stresses, and it has a much higher resistance to wear than is true of cast iron or many classes of steel. It machines easily, being free from hard spots which damage cutting tools.

Without entering into an extended discussion of the metallurgy and the chemical composition of "Gunite," it will be of interest to briefly examine micrographs of a typical cast iron, a typical semi-steel and of "Gunite" (see Figs. 1, 2, and 3). From the reproductions of these micrographs, which show 750 diameters magnification, it will be apparent that cast iron is of quite a variable composition, consisting of large areas of grahitic carbon, ferrite, pearlite and cementite. In semi-steel there is a similar structure, except that the ferrite is missing; and, in "Gunite" both the ferrite and cementite areas have been eliminated, leaving large areas of pearlite with uniformly distributed moderate sized flakes of graphite.

Let us consider what this means in giving to "Gunite" the physical properties required for many machine members subjected to difficult service conditions. In machining cast iron where accuracy is necessary, it is a common practice to cut away the hard outer skin, after which the piece is allowed to stand for a sufficient length of time so that strains in the metal may readjust themselves and thus complete distorting the casting. After this has occurred, subsequent machining can be done. The same general procedure must be followed where holes are to be bored or other openings cut in a casting.

With "Gunite," there is no tendency to form a hard outer skin, and owing to the uniform structure of the metal, it is exceptionally free from internal strains. As a result, "Gunite" castings can have their surfaces machined or holes may be cut, and such work carried to its conclusion, while the casting is on the machine. The freedom from internal strains eliminates the tendency toward distortion commonly experienced with cast iron.

As a practical test of freedom from distortion, it will be interesting to consider a case in which a builder of multiple drilling machines desired to make spindle guide bearing plates with accurately spaced holes. In one such case, the plates had thirty-four symmetrically spaced holes which were located and bored on a Swiss jig-boring machine. As a check of possible distortion, pairs of these plates were located, one above the other by the dowel-pin holes, and a 0.001 inch limit plug gage was passed through all the holes. After doing this, one plate was reversed, end for end, on the other and the test repeated, which proved conclusively that the holes had not only been accurately located

and bored, but that subsequent distortion of the metal had not impaired this accuracy.

In order to investigate the relative merits of "Gunite," malleable iron, cast steel, and semi-steel, as regards their resistance to distortion under bending loads, tests were conducted on frames for arbor presses in which "Gunite" was compared with other castings made of semi-steel. In these tests, the yield point for "Gunite" was not reached until a load of 21,000 pounds was applied, and at this point there was a deflection of 0.120 inch. The semi-steel casting reached the yield point under a load of 14,000 pounds, and under this load there was a deflection of 0.110 inch. This capacity of "Gunite" to resist deflection makes the metal especially valuable for the construction of machine tool members and for a variety of other classes of service where satisfactory results can only be secured by holding machine members rigid within very close limits of tolerance. The resistance of "Gunite" to deflection is explained by the uniform structure of the metal and its freedom from internal strains.

The ability of "Gunite" to resist wear is attributable to the presence of uniformly distributed graphite flakes, capable of exerting a lubricating action between members running together under friction, and to the absence of areas of pure ferrite and cementite. Ferrite areas are soft, so that they wear away rapidly, thus leaving the areas of hard cementite which are not only hard, but left higher than the surrounding surfaces, creating a condition favorable to rapid wear of machine members running in contact with such surfaces. There also is no tendency for the action known as "galling" to occur, which consists of the abrading of particles

Fig. 3. Micrograph of Gunite, 750 Diameters Magnification. This Shows how the Soft Ferrite and Hard Cementite have been Eliminated

of metal and the welding of these on other portions of the contacting machine surfaces. This action often occurs when steel surfaces run together.

The ability of "Gunite" to resist wear under friction has led to its successful application in the construction of machine tool members on which bearing surfaces are required, for automobile brake drums—especially on heavy passenger buses and trucks—for clutch friction plates, cams, gears, etc.

To obtain a numerical measure of the relative resistance to wear of "Gunite," semi-steel, and gray iron, the following method was employed: A wheel was made of cold-rolled steel, casehardened on the periphery, and polished. Test bars to be run in frictional contact with this wheel were first carefully weighed and then run in contact with the wheel, under the same load for the same length of time. The test bars were then weighed again, and the amount of metal worn away during the test obtained by difference. For the tests referred to,

Strength and Hardness of Gunite, Semi-steel and Gray Iron

Material	Tensile Strength, Pounds per Sq. Inch	Compression Strength, Pounds per Sq. Inch	Hardness, Brinell
Gunite	35,000	121,000 ultimate 60,000 yield point	180
Gunite Heat-treated	.....	225,000 ultimate 140,000 yield point	477
Semi-steel	28,000	99,000 ultimate 45,000 yield point	212
Gray Iron	21,000	86,000 ultimate 42,000 yield point	187

Machinery

the results were as follows: "Gunite," 2.30 grammes; semi-steel, 10.60 grammes for the first test and 7.75 grammes for the second test; gray iron, 8.70 grammes for the first test and 11.20 grammes for the second test. For the tests on semi-steel and gray iron, two different grades of metal were used.

"Gunite" is melted and processed in a modified form of reverberatory furnace. The charge is placed on a hearth lined with silica, and the furnace is heated by a coal flame passing over the metal. Coal for this purpose must be very low in sulphur, as the maximum allowable sulphur content is 0.04 per cent. Similarly, phosphorus must not exceed 0.18 per cent. The furnace is provided with tuyeres at a point just before the flame reaches the metal, thus providing for the maximum temperature to be reached when the flame impinges on the metal.

A charge of 7 tons is melted at a time, and after this metal reaches a molten condition, it is thoroughly stirred and the slag skimmed off. The metal is then kept under a temperature of about 3000 degrees F. for fifty minutes, the purpose being to give it the required degree of superheat. During this period conditions are maintained for retarding the precipitation of the carbon in the form of graphite, and after the expiration of the fifty minute period, the metal is again stirred and skimmed. It may then be drawn off into ladles and poured into the molds in the usual way. Just before pouring, an addition is made to the contents of the ladle which controls the precipitation of carbon in the form of graphite flakes, uniformly distributed and of uniform size as exhibited in the micrograph. Owing to this uniform distribution and small size of the graphite particles, the metal is close-grained and exhibits a smooth clean surface.

The comparative figures in the accompanying table give the strength and hardness of "Gunite," semi-steel and gray iron. These tests (made at Armour Institute of Technology) were on samples from large castings to get results representing average service conditions. Test bars cast to shape and size would show higher figures.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

SOCIETE GENEVOISE PRECISION THREAD GRINDING MACHINE

A precision thread grinding machine intended for the production grinding of thread gages, taps, hardened worms, micrometer screws, etc., to a high degree of accuracy with regard to the pitch, diameter, and profile of the threads, has recently been brought out by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland. This machine is being introduced on the American market by the R. Y. Ferner Co., Investment Building, Washington, D. C. It is designated as the "Filor" and differs in many respects from the other type of thread grinder made by the same firm, which was described on page 153 of October, 1925, MACHINERY. The machine is fully automatic and the feed of the grinding wheel can be stopped at any desired point. Pieces may be produced to the same size within a few ten-thousandths of an inch without measuring.

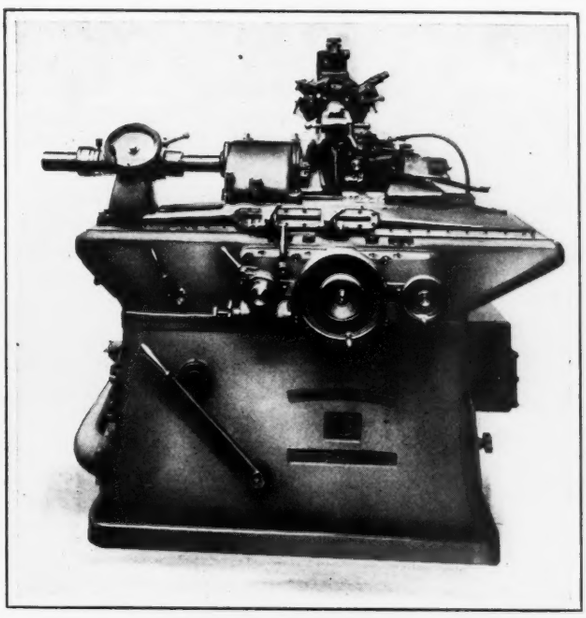


Fig. 1. Societe Genevoise Precision Thread Grinding Machine

The maximum distance between centers is 12 inches, and the maximum length of thread that can be ground is 4 3/4 inches. By making an axial adjustment of a nut on a master screw which controls the work-table, it is possible to obtain the useful grinding travel on any section of work. Parts up to 3 1/8 inches in diameter can be ground with a new wheel, while a worn-out wheel will grind pieces as large as 5 inches in diameter.

With a view to obtaining maximum production, the machine is designed to grind during the return motion, as well as on the forward travel. The master screw which controls the work-table is rigidly fixed to the end of the main spindle. Interchangeable master screws are furnished to suit the work. The main spindle is driven alternately by an oscillating shaft having universal joints, which receives power from a speed gear box at the rear of the machine. Force tending to pull the work-table toward the left is constantly applied to the master screw by means of a counterweight, so as to eliminate any play in the nut of the master screw. By this means, the work is made to execute a helical motion corresponding to that of the master screw, without any relative displacement when reversing, and the grinding wheel, which is fixed in the axial direction, cuts a correct geometrical helix. The main spindle is lubricated by an automatic oil-circulation system provided in the headstock.

The nut of the master screw is carried by a heavy sleeve which has a fine adjustment to permit accurately locating the threads of roughed out work in relation to the grinding wheel. The adjustment amounts to 0.01 inch per revolution of the handwheel. After a setting has been made, the sleeve is clamped in its support. Master screws can be quickly substituted.

A grinding wheel of comparatively large diameter—17 3/4 inches—is employed so as to minimize wear of the wheel during the grinding of a series of similar work. At one of the dead points in the table travel, the feed-screw of the grinding wheel is operated by an automatic pawl device, which can be adjusted to give any feed between 0.0002 and 0.002 inch. Feeds can be changed without interrupting grinding. This pawl device can also be controlled by hand without interfering with the automatic feed.

A micrometer stop, which is concentric with the feed-screw of the grinding wheel, limits the travel of the wheel, so that the same diameter is automatically obtained for all work pieces of a series. By means of this provision, one operator can control several "Filor" machines, grinding similar work to the same size within from 0.00012 to 0.00016 inch. The micrometer stop can be adjusted by a handwheel graduated to 0.00005 inch.

The bearings of the grinding wheel are carried by a tilting cradle which can be readily set to the mean lead angle of the thread to be ground. The normal speed of the wheel-spindle is 1360 revolutions per minute, but by means of planetary gearing located in an idler pulley, the grinding wheel can be run at a reduced speed of 88 revolutions per minute for rough dressing. The last dressing cuts, however, are always taken at the working speed.

The wheel is trued by a single diamond which is arranged to dress the flanks successively and to generate the rounding of the profile required for various threads. The radius of the rounding is measured by means of a micrometer screw equipped with a reading drum.

The reversal of the work-spindle is accomplished by a double friction clutch operated by oil pressure.

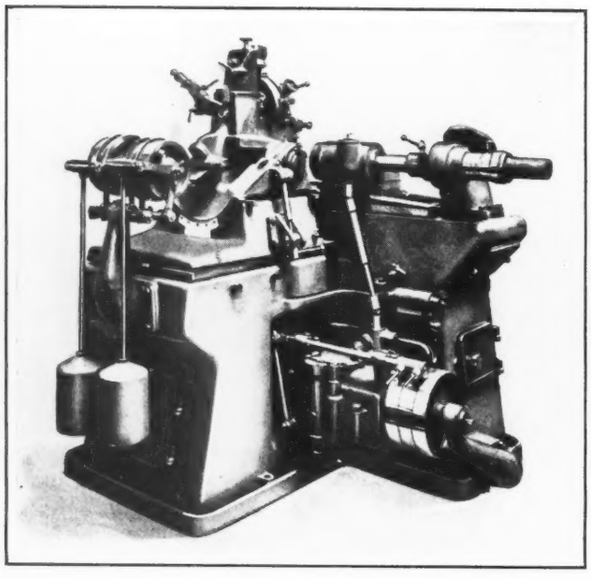


Fig. 2. Rear View of Thread Grinding Machine Showing Drive, Speed-box, etc.

Oil is supplied by a geared pump located in the speed gear box, and is distributed by a piston valve to the two clutches. The distributor is controlled by sliding dogs on the table or a trip lever. This system of reversing is silent and eliminates all shock. By merely interchanging the connecting point of a link that controls the distributor, grinding operations can be changed to suit right-hand and left-hand threads.

Through a shifting pinion in the speed gear box, four spindle speeds ranging from 9 to 46 revolutions per minute are obtainable, these speeds being suitable for rough-grinding threads from 1/4 to 3 inches in diameter. To obtain a high polish, it is possible to drive the gear-box through a reduced-speed pulley which operates the main spindle at speeds ranging from 2.6 to 12.8 revolutions per minute. The roughing and finishing speeds, as well as the stopping of the machine, can be controlled through a single lever at the front, which is employed to shift the driving belt.

A swiveling microscope mounted on the tailstock, provided with an electric illuminating device, permits thorough examination of thread profiles. A pump of the centrifugal type delivers coolant to the work and grinding wheel from a tank bolted to the right-hand side of the bed, which holds about 5 1/2 gallons of water. This machine weighs about 5320 pounds.

GENERAL ELECTRIC REVERSING SWITCH

A new motor control switch suitable for reversing small alternating-current motors in cases where the motor can be thrown across the line has been brought out by the General Electric Co., Schenectady, N. Y. The new switch consists of two triple-pole, barrier-type, magnetically operated contactors, mechanically and electrically interlocked, and two hand-reset temperature overload relays mounted on a molded base and enclosed in a drawn-shell case. The double-break contactors have silver contacts and are operated by a high-speed solenoid.

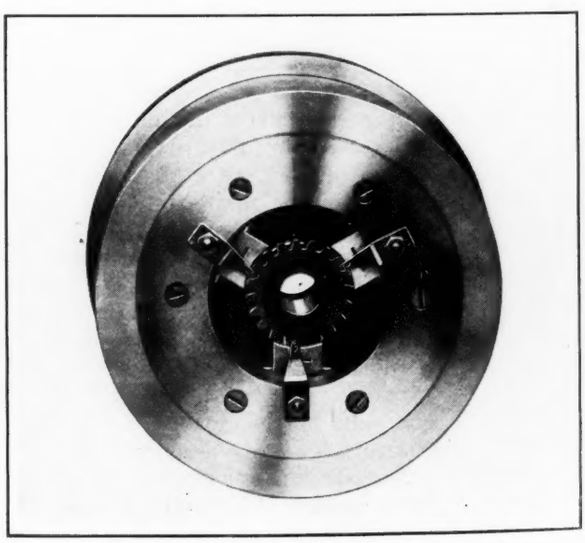
This switch is intended for application on general-purpose motors when reversing is required. Many machine tool applications require a reversing switch of this type. Two temperature overload relays are a fixed part of the switch, but have interchangeable heaters. The size and appearance of the switch are such that it can be readily mounted on any machine to which it would be applicable.

BOLENDER POWER-OPERATED GEAR-GRINDING CHUCK

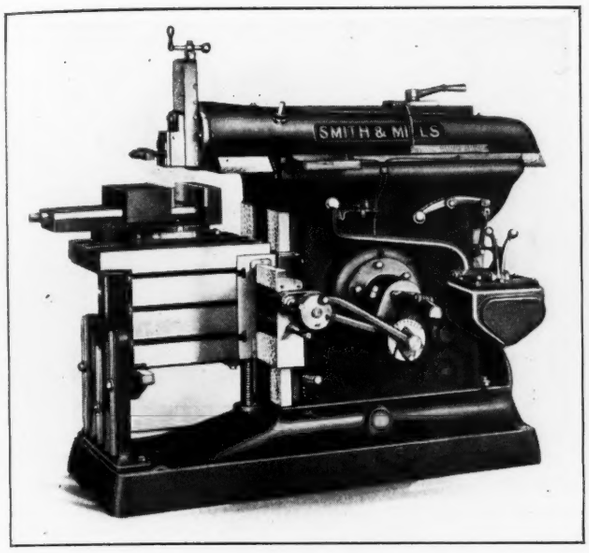
A power-operated gear-grinding chuck has been brought out by the City Machine & Tool Works, 1517-1531 E. 3rd St., Dayton, Ohio, to supplement the hand-operated gear-grinding chuck made by this concern. The hand-operated chuck was described in January, 1924, MACHINERY, page 403. The construction of the power-operated chuck is the reverse of the hand-operated chuck, the inner member moving and the outer member being fastened to the machine spindle. This design materially decreases the loading time, whether the chuck is operated by a lever or by air. In one application of the new chuck in which a 13/16-inch hole of a bronze bushing pressed into a gear is ground, the gear is chucked, ground, and unchucked in a floor-to-floor time which ranges from thirteen to fifteen seconds.

All the features of the previous chuck, such as protection against emery dust, water, etc., and quick-change jaws, are retained in the new device, and in some cases improved. The mechanism is completely lubricated through a Zerk oiler, which also prevents the entry of foreign matter. The hardened and ground locating pins on which the teeth of the gear to be ground are located, are held in position by clips, this feature eliminating handling of the pins. These locating pins are removable to suit tubular work or to permit the use of special jaws.

The gears are loaded into the chuck from the front for grinding the bores concentric with the pitch circle of the teeth. Various kinds of irregular work can be accommodated through the use of special quick-change jaws. Long life of the chuck is assured by provision for changing the bearing surface of the ring. Four screws are used for centering the chuck on a faceplate. Spur, bevel, spiral, and worm gears can be accommodated.



Bolender Gear-grinding Chuck Operated by Power



Smith & Mills Shaper with V-type Ram

SMITH & MILLS BACK-GEARED CRANK SHAPERS

The shapers of the entire line built by the Smith & Mills Co., 2889-91 Spring Grove Ave., Cincinnati, Ohio, are now provided with V-type rams. The illustration is typical of the 16-, 20-, and 25-inch sizes. These shapers, except for the new type of ram and various other improvements, are similar to the improved design described on page 9 of September, 1927, MACHINERY.

The new ram has 55-degree V-ways. The cap and gib are of one-piece construction for the full length, and have a single horizontal adjustment to compensate for wear of the bearing surfaces. The ram is of heavy box construction and has wide bearing surfaces. The ram carrier has been lengthened, and a screw adjustment is provided so that the ram may be positioned in relation to the work while the machine is in motion or at rest. The column has been extended at the rear to furnish long bearing surfaces for the ram and the overhang of the column at the front has been eliminated to permit bringing the work closer to the column proper. The ram ways are fitted with felt inserts connected to the oiling arrangement, and oil traps are provided at the front and rear of the column to retain the oil.

Another improvement in these shapers is the table support. A housing for the adjustable support block is bolted to the base of the shaper at the front. Since the support block is always in contact with the table, adequate bearing is provided even when the table is fed to the extreme ends. Felt wipers prevent dirt and chips from coming in contact with the table and the support-block surfaces.

A single-pulley drive equipped with a "Twin Disc" clutch and a self-acting brake can be furnished, as well as motor and cone pulley driving arrangements. Four changes of speed are obtainable through a unit type of speed-box, which is bolted to one side and the back of the column. These changes, in combination with back-gears, afford eight cutting speeds. All shifting gears slide on multiple-spline shafts mounted in Timken tapered roller bearings. There is an internal ratchet feed with all parts enclosed inside the feed gear. On the solid feed-rod there is a graduated disk. Automatic vertical and horizontal table feeds are available in either direction. A one-shot foot-operated lubricator supplies oil to all main revolving shaft bearings and the ram ways, as well as to parts on the inside of the shaper.

"DINKEY" CONTROLLER

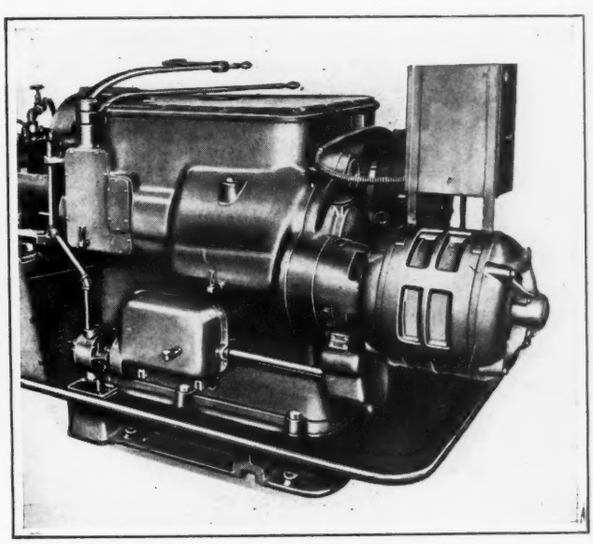
A controller designed principally for governing the various movements of traveling cranes and similar material-handling apparatus has recently been brought out by the Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, Ohio. In this controller, ebony asbestos is used instead of slate. The ventilated contacts are raised 9/16 inch from the dial face. The contact supporting lugs are attached to the front of the dial and are removable from the front. The contact lug is provided with a single set-screw for tightly clamping the lead wire.

The frame of this controller is made of welded steel, and the main arm is carried on ball bearings. A bearing-spider casting supports the dial, as well as the arm and quadrant bearings, insuring correct alignment and even contact pressure. Nickel-alloy resistors are provided.

IMPROVED MOTOR DRIVE FOR LIBBY-INTERNATIONAL TURRET LATHES

A new method of applying motor drives to Libby-International heavy-duty turret lathes built by the International Machine Tool Co., Indianapolis, Ind., has recently been developed by that concern. In this drive, the motor is attached directly to the primary shaft by means of a coupling of the flexible type. A 20- or 25-horsepower motor of the drum type, running at 1800 revolutions per minute, is used. Motor manufacturers have arranged to supply the end frame of this size and type of motor with a ring which fastens directly to a bracket on the machine, thus making a compact arrangement. This drive is used only on the types H and CH turret lathes.

The improved motor drive does away with pulleys, sprockets, belts, chains, etc. It also eliminates

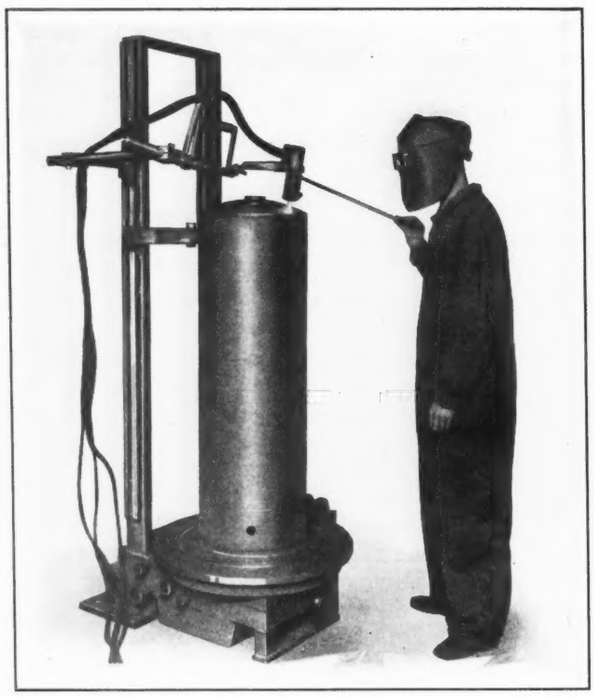


Libby-International Turret Lathe Equipped with Improved Motor Drive

side pull on the motor bearing and loss of power from slippage of belts. It is also possible by means of a bracket to use a standard motor, but this arrangement is not so neat or compact as that illustrated. As there is no difference in the motor except in the end frame next to the machine, the manufacturer advises the use of the drum-type motor.

LINCOLN ELECTRONIC-TORNADO WELDER FOR SMALL TANKS

An automatic arc welder employing the electronic-tornado principle has recently been developed by the Lincoln Electric Co., Coit Road and Kirby Ave., Cleveland, Ohio, for welding the head in small tanks, such as range boilers, oil and gas tanks, etc. This machine has a holding fixture, which consists of a rotating table driven by a small variable-speed motor. A vertical support carries a fixed steadyrest and the welding head. The latter is flexibly mounted so that the length of the arc is always under the control of the operator.

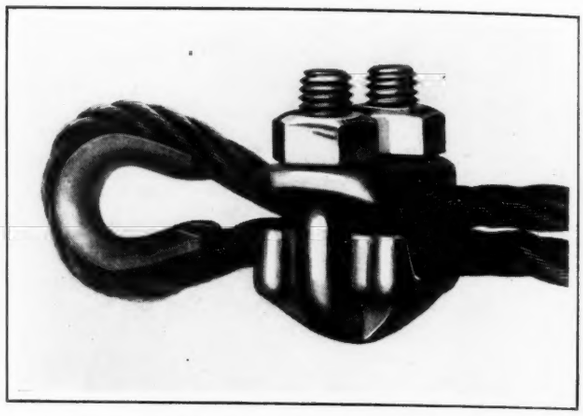


Lincoln Automatic Arc Welder which Uses the Electronic-tornado Principle

In making an edge weld as illustrated, no additional filler metal is used, the heat of the carbon arc fusing the edges of the cylinder shell with the flange of the dished head to make a leak-proof joint. Welding speeds of from 100 to 150 feet per hour are claimed for the machine. It will be noted that the framework is built entirely from welded steel, which is the type of construction employed for the standard line of motors and welders manufactured by this concern.

EUREKA CABLE CLIPS

Patented cable clips having two jaws that are grooved for the cable, as illustrated, are being placed on the market in a full range of sizes by the Eureka Metal Products Corporation, North East, Pa. These clips have only four parts, the one grooved jaw being peened to the U-bolt. As large surfaces of both the top and bottom jaws are grooved to accommodate the cable, no portion of the cable is gripped by the U-bolt, and there is no chance of injuring the cable no matter how tightly the nuts are drawn up. Unusual load-carrying capacity is claimed for these clips, which are known by the trade name of "Triple-Strength." The clips are made in steel and bronze.

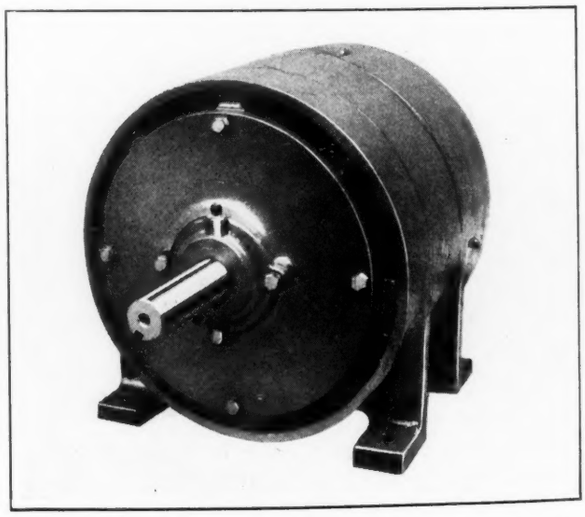


Eureka Cable Clip which has Two Grooved Jaws

FAN-COOLED TOTALLY ENCLOSED MOTOR

A totally enclosed fan-cooled electric motor designed to keep the windings free from metal dust, oil, water, or other undesirable substances, is being placed on the market by the Cleveland Electric Motor Co., 5213 Windsor Ave., Cleveland, Ohio. This "Security" motor is built with a double shell, and is equipped with ball bearings.

The inner shell, which contains the entire motor, is completely enclosed, and is thus entirely dustproof. The inner shell is so mounted in the outer shell as to allow a free air space between the two shells, the shaft passing through both. One end cover of the outer shell is provided with holes to admit air, while at the end away from the motor pulley, a fan is employed in the space between the inner and outer end covers. This fan draws a steady current of air through the holes, and blows

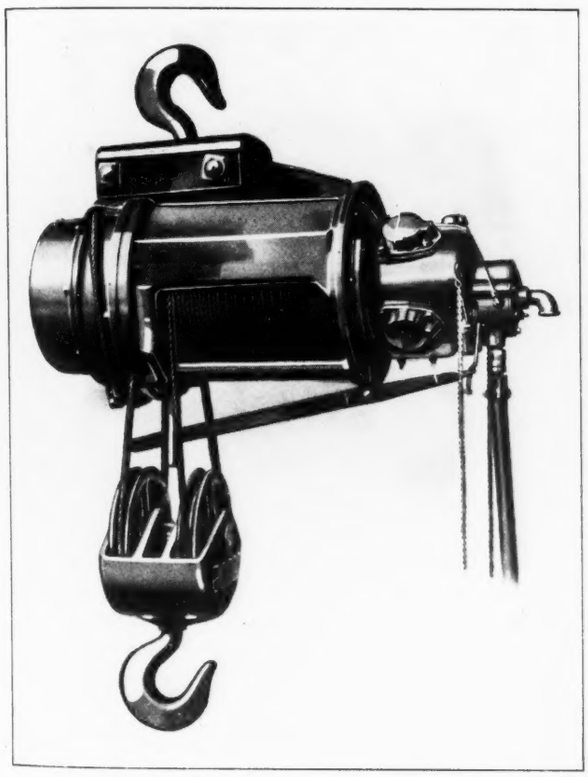


Fan-cooled Fully Enclosed Motor Made by the Cleveland Electric Motor Co.

it over the outer surface of the inner shell. With this design, an ample cooling effect is obtained and dust is entirely excluded from the working parts. The design permits practically the same rating for a given frame size as for an open-type motor.

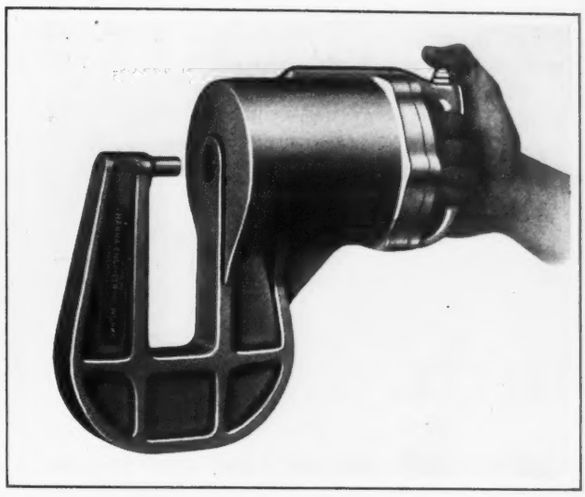
INGERSOLL-RAND AIR MOTOR HOIST

An air motor hoist of 20,000 pounds capacity has recently been developed by the Ingersoll-Rand Co., 11 Broadway, New York City, as shown in the illustration. This hoist is intended for such use as handling locomotive drivers around lathes and presses in railroad shops, and for other heavy lifting work which would ordinarily tie up a crane. The hoist consists of a four-cylinder air motor geared to a rope drum, both of which are enclosed in a compact dirtproof housing. The gears are heat-treated and operate in a bath of semi-fluid grease. Ball bearings or bronze bushings are provided at various points.



Ingersoll-Rand Air Motor Hoist of 10 Tons Capacity

An automatic safety brake of similar design to that used in other Ingersoll-Rand air hoists is incorporated in the new size. This brake automatically holds the load in any desired position for any length of time, regardless of the air pressure. Instant control of the hoist movement is obtained through a graduated throttle and a well balanced motor, the latter being practically without vibration. The cylinders are renewable and interchangeable, making it easy to replace cylinders worn in service. The hoist can be furnished with either a top hook or a chain-driven trolley. Special trolleys can be made to meet requirements. The maximum lift of the hoist is 16 feet. Equipped with a top hook, it weighs 1300 pounds, and equipped with a chain-driven trolley, 1800 pounds.



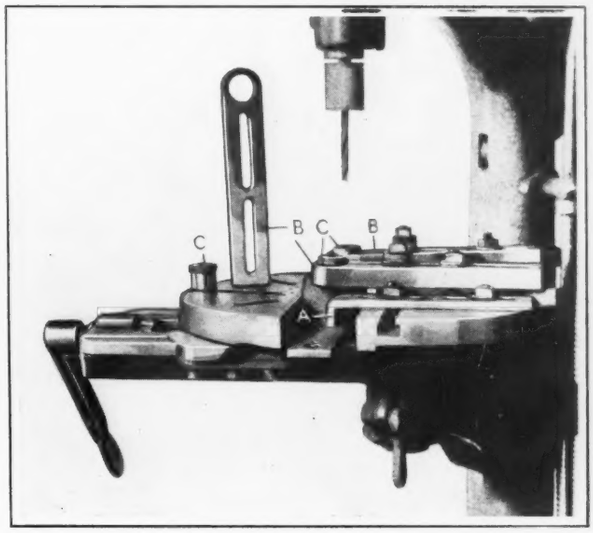
Hanna Portable Pneumatic Riveter which Exerts a Force of One Ton

HANNA PORTABLE PNEUMATIC RIVETER

A portable pneumatic riveter which weighs only 15 pounds and exerts a pressure of 1 ton on the dies, is being placed on the market by the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. This portable riveter has a 5-inch depth of throat or reach, a 2-inch gap, and a 1-inch die stroke. It is capable of driving tubular bronze or steel rivets up to 3/16 inch in diameter, and is particularly adapted to riveting automobile hoods, instrument panels, bodies, etc.

UNIVERSAL JIG FOR COMBINATION DRILL TABLE AND VISE

Special parts intended for use as a universal jig in conjunction with the combination drill table and vise manufactured by the Modern Machine Tool Co., Jackson, Mich., have been placed on the market by that concern. Combination drill tables and vises of the type referred to were described in the May, 1926, and February, 1925, numbers of MACHINERY. As shown in the accompanying illustration, a stop *A* is bolted to the top of the combination drill table and vise, and bushing plates *B*



Universal Jig Arrangement or Combination Drill Table and Vise

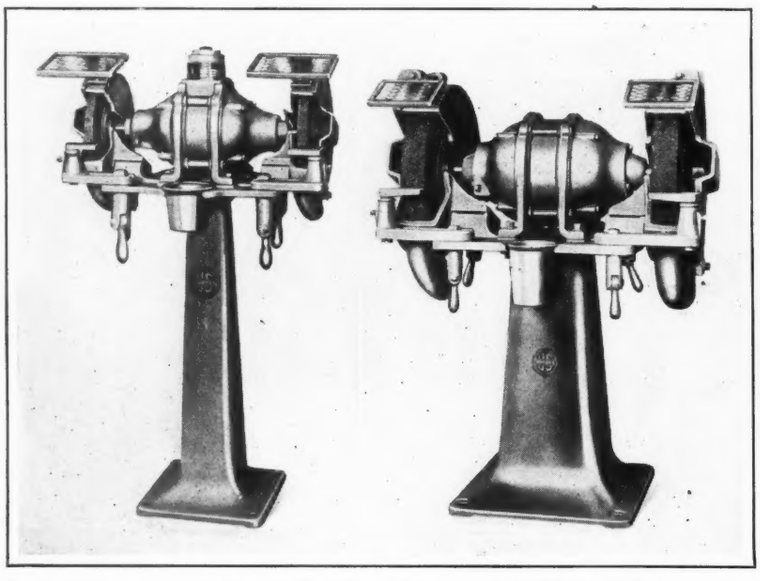
are then placed over the work, as required. These bushing plates are equipped with from one to four bushings *C* of proper size.

This arrangement may be used for various classes of work. After a sample piece has been clamped in the vise and the stop and bushing plates adjusted, duplicate pieces of work can be conveniently drilled. The bushing plates may be bolted to the table by using the table slots or they may be set on parallels to any height required by the work. By raising the bushings slightly out of their plates, the center distances between the bushings may be easily determined with a micrometer. The bushing plates are designed to receive standard bushings.

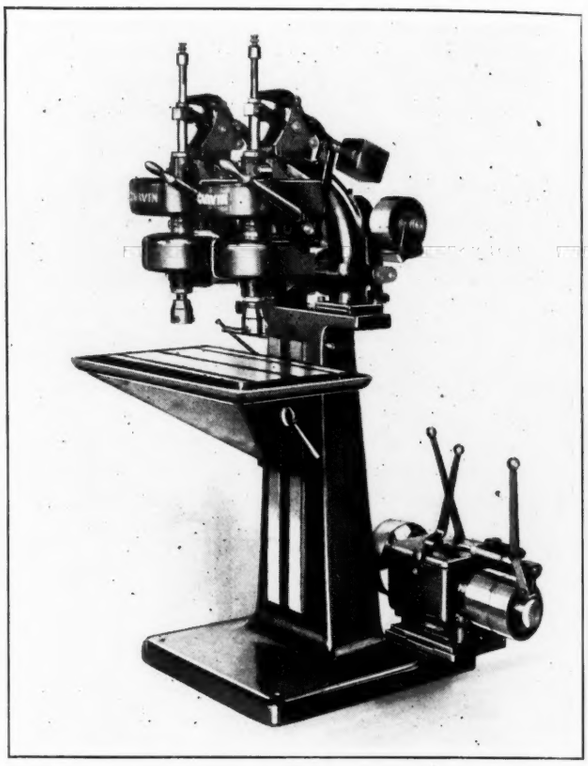
IMPROVED "AUTOSTART" GRINDERS

"AutoStart" grinders, termed 1930 models, are being introduced on the market by the U. S. Electrical Mfg. Co., Los Angeles, Calif. These grinders embody several new features, including transparent eye-guards and sliding and adjustable tool-rests. The grinders are mounted either on pedestals, as shown, or on bench bases. They are operated by enclosed asbestos-protected motors which are guarded against the entry of dust, grit, or other foreign substances. The motors are built on the "AutoStart" principle, in which the use of compensators or hand starters is eliminated. Each motor is started instantly by merely pressing a button. The windings are completely embedded and insulated with "Asbestosite," which is said to prevent carbonization of the insulation.

The eye-guards or chip shields are made of glass reinforced with heavy wire. These guards permit the grinding operation to be clearly seen. A simple adjustment enables the proper guard clearance, regardless of the diameter of the grinding wheels. When a wheel becomes worn down, the entire wheel guard can be slid back. The tool-rests slide with the wheel guards, so that the same amount of clearance is obtained regardless of wheel diameters. The wheels can be easily replaced, as their inner flanges are keyed to the shafts. The tool-rests are equipped with handy locking levers.



Two Improved Grinders Built by the U. S. Electrical Mfg. Co.



Garvin Duplex Automatic Tapping Machine Equipped with Speed-box

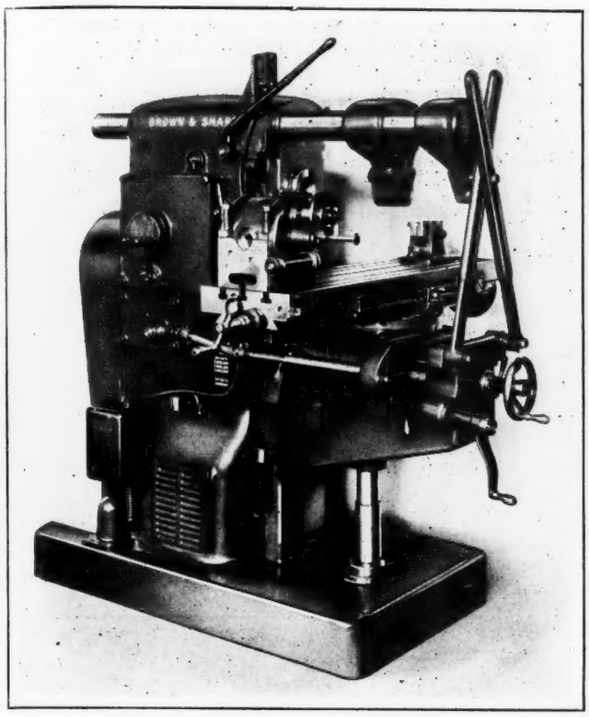
GARVIN DUPLEX AUTOMATIC TAPPING MACHINE WITH SPEED-BOX

The four-change speed-box recently brought out by the Western Machine Tool Works, Holland, Mich., has now been applied to the Garvin No. 2-X duplex automatic tapping machine, as shown in the accompanying illustration. June MACHINERY, on page 807, contained an article describing this speed-box and showing its application to a single-spindle automatic tapping machine. The speed-box may be furnished for either direct motor-driven or single-pulley driven machines. It is fitted with Timken tapered roller bearings throughout. All gears, Timken bearings, shafts, shifter forks, and lever fulcrums are lubricated by a bath of oil.

"IMPERIAL" ROLLER-BEARING HAND-OPERATED PUNCH

A No. 7 1/2 lever-type hand-operated punch has recently been added to the products of the Whitney Metal Tool Co., Rockford, Ill. This punch is similar in design to the Nos. 7 and 8, and represents an equal division between the two with regard to capacity and weight. It is capable of punching 1/4-inch holes through 3/16-inch plate, and weighs 10 1/2 pounds. The No. 8 punch was illustrated in May, 1925, MACHINERY.

The handles of all three of these punches may be moved apart any amount up to 90 degrees. Roller bearings offset friction and facilitate operation of the handles.



Brown & Sharpe No. 1A Universal "Standard" Milling Machine with Motor Drive

BROWN & SHARPE UNIVERSAL AND PLAIN "STANDARD" MILLING MACHINES

Two more machines have been added to the line of "Standard" milling machines built by the Brown & Sharpe Mfg. Co., Providence, R. I., which were described in February MACHINERY, page 474. The new machines comprise a No. 1A universal and a No. 1B plain. In general, these machines are similar to those dealt with in the previous article, but they have a slightly smaller capacity and are not regularly equipped with the power fast travel, the dual control for feed changes, or a pump. When desired, however, the machines can be furnished with the power fast travel and a pump.

The new machines are of the motor-in-the-base type, have a double over-arm construction, and are provided with an automatic longitudinal and transverse table feed. The vertical feed of the table is accomplished by hand. Either a belt or motor drive can be supplied, the illustration showing a No. 1A universal machine equipped with a motor drive. A single lever at the front of the machine is operated to make feed changes. Speed changes in two series are obtained by the operation of a lever on the column. Direct-reading dials in both cases indicate the feed or speed for which the machine is set.

The spindle is mounted on three roller bearings, two at the front and one at the rear, and means of adjustment are provided. Automatic lubrication throughout is obtained with a pump in the column for delivering oil to all mechanisms within the column and to the driving pulley, while automatic lubrication of the knee mechanism is obtained with a separate pump. The knee may be clamped from either the front or rear of the table by a single lever. It is provided with a one-piece screw which is completely guarded and does not extend below the floor. The driving clutch is of the dry multiple-disk type, and is located outside the column. It is operated by a lever on the side of the machine.

STARRETT HIGH-SPEED HACKSAW BLADES

The L. S. Starrett Co., Athol, Mass., has added to its line of hacksaw blades, the No. 840 high-speed blades for hand use, and the No. 850 for power sawing. These blades are made of a special steel, and although their initial cost is higher than that of the tungsten alloy blades, they are said to reduce the cost per cut due to the fact that they speed up production and have a longer life. The new hacksaw blades come in 10- and 12-inch lengths for hand service, and 12-, 14- and 17-inch lengths for power service.

U. S. ELECTRICAL HIGH-SPEED GRINDER AND PORTABLE DISK SANDER

With wheels 30 inches in diameter, a speed of 9500 surface feet per minute is obtainable on a new high-speed grinding and snagging machine built by the United States Electrical Tool Co., 2477 W. Sixth St., Cincinnati, Ohio, operating on 40- or 60-cycle current. When worn down to 24 inches in diameter, the wheel runs at 7500 surface feet per minute. This machine is illustrated in Fig. 1. When it is operated on 25- and 50-cycle circuits, a 24-inch wheel runs at a speed of 9200 surface feet per minute. Wheels having a face width of 2 1/2 or 3 inches are used. The machine is furnished for operation on 220-, 440- and 550-volt, two- or three-phase alternating current or 220-volt direct current. The motor is of 15-horsepower capacity.

The wheel flanges of this "Hispeed" snagger are keyed to the shaft and clamped to the wheel with cap-screws. The structural steel safety hoods provided over the wheels are built for wheel speeds of 10,000 surface feet per minute. The doors on the safety hoods are fastened on by cap-screws. The shaft is made of nickel steel, in one piece, and is

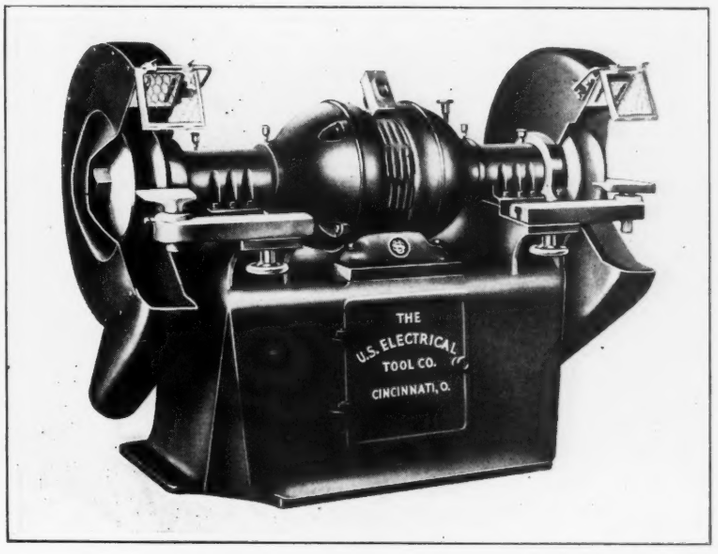


Fig. 1. High-speed Grinding and Snagging Machine Built by the United States Electrical Tool Co.

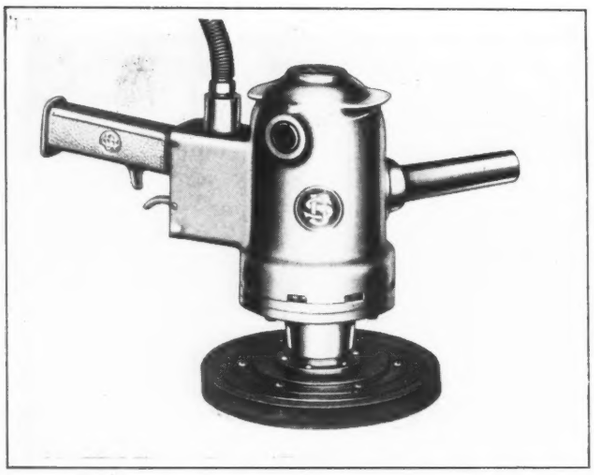


Fig. 2. U. S. Electrical Portable Disk Sander

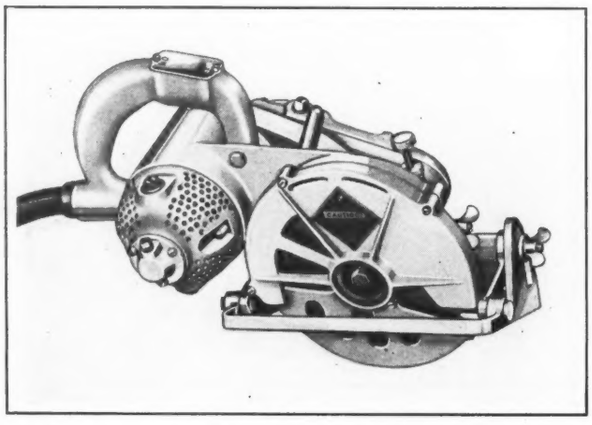
mounted on four heavy-duty ball bearings contained in dustproof housings.

The same concern is also introducing to the trade at this time the portable disk sander shown in Fig. 2. This device is equipped with a fan-cooled universal motor which operates the 9-inch disk at a speed of 3600 revolutions per minute under load. Ball bearings are provided throughout, and there is a two-pole trigger switch in the handle. Fine, medium, and coarse sanding disks are furnished. The weight of the sander is 12 pounds.

"ALTA" SMALL HAND-SAW

A small electric hand-saw having a cutting capacity of 2 inches is the latest addition to the "Alta" line of portable electric tools manufactured by the Wappat Gear Works, Inc., 7522-26 Meade St., Pittsburgh, Pa. The lower safety guard, which is a patented feature, completely encloses the saw blade. It opens gradually by telescoping into the upper guard as the saw is pushed into the material, and snaps shut when the cut is finished. Thus, protection is afforded to the operator and to the saw blade.

This hand-saw is built in three models, one of which is intended for plain, square cutting; one for bevel cutting; and one for grooving, the latter being equipped with an adjustable dado cutter. On all three models the shoe is adjustable vertically, making it possible to set the saw for cutting to any required depth. The saw may be used on soft metals, wood, bakelite, fiber, and other materials.

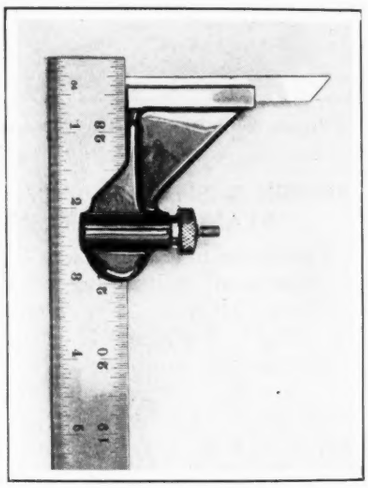


"Alta" Saw for Cutting Soft Metals, Bakelite, Wood, etc.

A high-speed universal type fan-cooled motor, mounted on ball bearings, furnishes the power. It also directs a blast of air in front of the saw to clear away sawdust and make it possible for the user to follow a line accurately. A handy steel table to which the saw can be attached, can be furnished.

HEIGHT-GAGE ATTACHMENTS FOR COMBINATION SQUARES AND SETS

Height-gage attachments Nos. 465A and 465B have been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I., for use with combination squares and sets. The attachments are mounted on the blades of combination squares and sets to convert them into height gages, the vertical height of the scriber point on the attachments being read directly from the blade, as may be seen in the accompanying illustration. The attachments may be used in all positions from the extreme top to the extreme bottom of the blades. They are also reversible, and can be used on either side of the blades, which gives the greatest possible range of measurement.



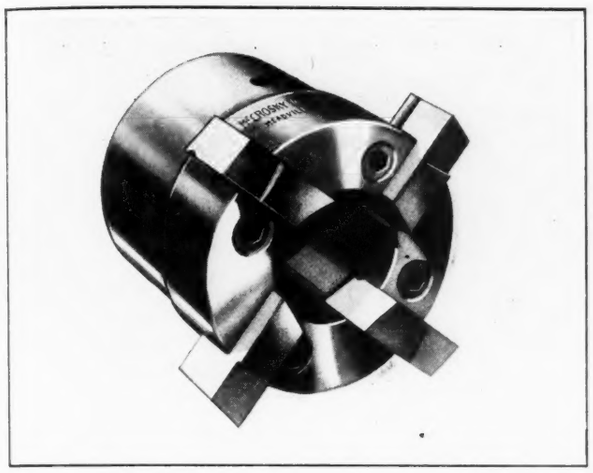
Brown & Sharpe Height-gage Attachment

The frame of the attachments is drop-forged and has a smooth japanned finish. The pointer is made of steel and is hardened, tempered, and ground. The inside end of the pointer projects from the body of the attachment to the edge of the blade, so that the height at which the pointer is set can be easily read.

These attachments are handy in making comparative measurements, finding heights from plane surfaces, etc. The No. 465A size is intended for use on B & S combination squares or sets having 9-inch blades, and the No. 465B, on B & S combination squares or sets having 12-, 18-, or 24-inch blades. The attachments cannot be used on squares or sets having heavy blades.

MC CROSKY FOUR-POINT BORING HEAD

A four-point boring head is being introduced to the trade by the McCrosky Tool Corporation, Meadville, Pa., which has four high-speed steel blades rigidly locked in a hardened steel body by an adaptation of the locking device used in the McCrosky "Super" adjustable reamers. There is a groove in each blade which receives a drill rod pin embedded in a groove in the body. A hollow set-screw bears against the pin, forcing it tightly into the groove in the blade. This construction locks the blade rigidly in the body and permits the head to take unusually heavy cuts.



McCrosky Boring Head of Four-point Construction

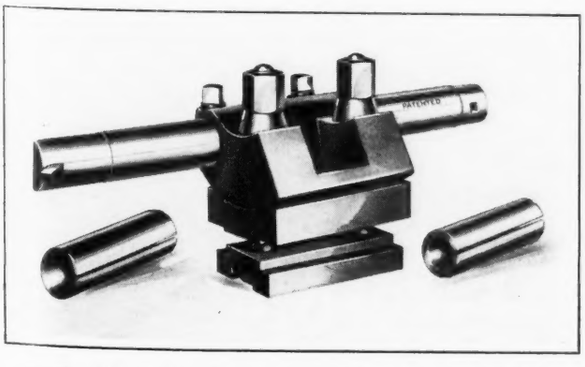
A wide radial adjustment of the cutter blades is available. A head 3 inches in diameter has an adjustment of 1/4 inch, and a head 6 inches in diameter, an adjustment of 1/2 inch. The adjustment for other sizes of heads is in the same proportion. The head can be made in sizes from 2 1/2 inches up, to meet the specifications of definite boring jobs.

The large hole in the body of the head permits the use of a sturdy bar. A shell reamer can be mounted on the bar with the boring head, to provide for taking roughing and finishing cuts on work in one operation.

SCULLY ADJUSTABLE BORING AND TURNING BARS

Boring and turning bars of an adjustable design, mounted for use in a holder that may be applied quickly to a lathe, are being placed on the market by the Scully Steel & Iron Co., 2364 S. Ashland Ave., Chicago, Ill. These bars and holders are made in various sets, the holder of the smaller sets being intended to be mounted on the toolpost of a lathe, while the holder of the larger sets is mounted on the cross-slide after the toolpost has been removed. The illustration shows one of the larger sets.

In addition to boring and turning, these adjustable bars may be used for cutting either external or internal threads. They are of one-piece construction and made of alloy steel, the ends being hardened. High-speed steel cutters are held in the bars at the ends, by means of headless set-screws.



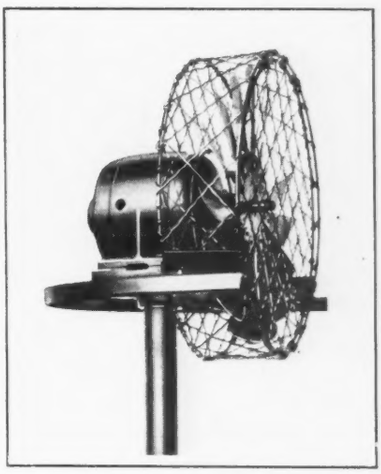
Scully Adjustable Boring and Turning Bar with Holder

The two holder parts are malleable iron castings. The upper member of the holder can be swiveled on the lower member, which provides unlimited adjustment of the bars. Any desired rake of the cutters can be obtained by making a bar adjustment. Bushings provide for holding bars of various diameters. The longest work that can be swung in a lathe may be turned the entire length by reversing the holder.

The smallest set of the series is equipped with collets for taking small forged one-piece tools having 1/4-, 3/8-, 1/2-, or 5/8-inch shanks. The largest bar of the largest set is 3 inches in diameter by 30 inches long.

PORTABLE SHOP FAN

A portable fan mounted on a pedestal so that it can be conveniently placed wherever men are engaged on hot or dusty jobs is made by the Peerless Electric Co., Warren, Ohio. This "Man Cooler" is constructed to withstand the bumps and knocks to which it is likely to be subjected in a shop. The guard is made of heavy gage wire screen, and the base is an iron casting, which is heavy enough to prevent accidental tipping.



Portable Shop Fan Made by the Peerless Electric Co.

The fan is 18 inches in diameter and is constructed of fifteen blades. It is driven by a 1/4-horsepower ball-bearing motor running at 1150 revolutions per minute, and at this speed the fan produces an air velocity of 1400 feet per minute. A swivel in the fan support permits it to be turned so that air can be directed into any part of a room. The fan is intended for use in steel mills, enameling, japanning and heat-treating departments, foundries, boiler rooms, etc.

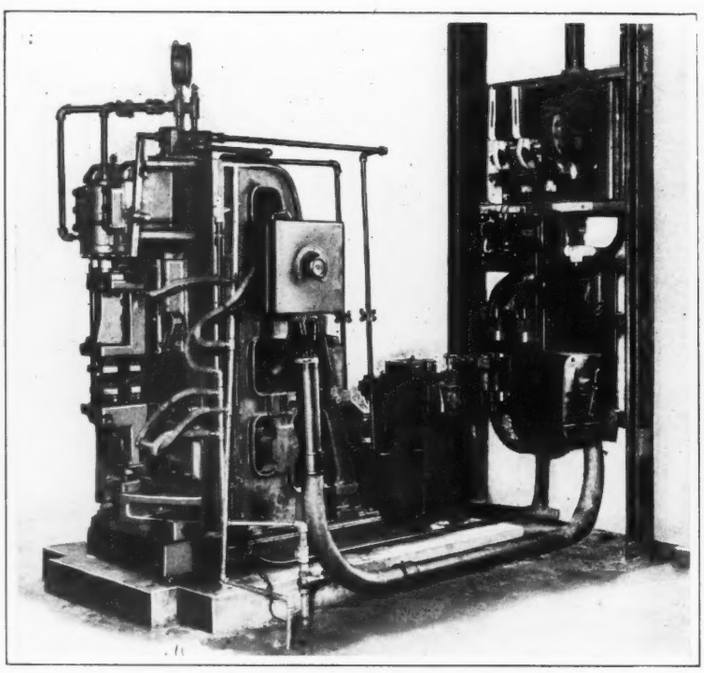
THOMSON ELECTRIC WELDER WITH HYDRAULIC PRESSURE DEVICE

A heavy-duty spot-welding machine has recently been built by the Thomson Electric Welding Co., Lynn, Mass., in which the pressure device consists of a 14 square-inch hydraulic cylinder which may be connected to either an accumulator system or to an "Oilgear" pump. The illustration shows the machine equipped with an adjustable-pressure constant-delivery "Oilgear" pump capable of delivering a pressure of 1000 pounds per square inch. A four-way manually operated valve governing the hydraulic system supply is mounted on top of the welder and is provided with a control lever which extends into a convenient position for the operator. The maximum stroke of the pressure cylinder is 3 inches.

This No. 40-AV welder is particularly applicable to the spot-welding of plates or structural shapes not over 1/2 or 5/8 inch thick, or any part requiring a heavy pressure and large transformer capacity. The machine can also be adapted to the making of multiple projection welds on stamped metal parts.

The frame of the welder consists of a cast subbase which supports two cast side frames of I-beam section on which is mounted a one-piece cast plate which carries the pressure cylinder unit and ways for the upper and lower horns or slides. The transformer is of the split core type, is air-cooled, has flexible copper secondaries, and has a rating of 250 kilovolt-amperes. The transformer is mounted at the rear between the two vertical side frames. Current control for different thicknesses of material is obtained through a five-point regulator switch mounted on the welder and connected to tapped primary coils of the transformer. Operation of the circuit is controlled through a push-button switch, mounted on the pressure-device control lever at the front of the machine. This switch is connected to a solenoid or operating coil of a magnetic wall contactor.

The horns or slides are made of cast copper and are water-cooled. The lower slide has a vertical adjustment of 4 inches, and the maximum distance between the faces of the upper and lower slides is



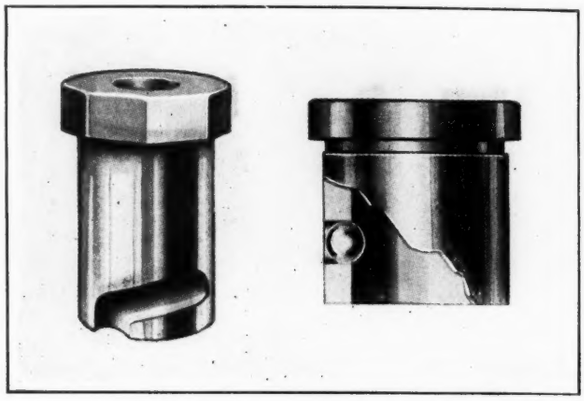
Thomson Electric Spot Welder Equipped with Hydraulically Actuated Pressure Device

10 1/2 inches. The distance from the outermost edge of the slides to the welder frame is 12 inches, while the distance from the frame to the center line of pressure is 8 1/2 inches. The slide faces are flat and approximately 7 inches square, which makes it possible to attach dies designed to suit various conditions.

When "Oilgear" equipment is used as the source of hydraulic pressure, it is recommended that a 7 1/2-horsepower motor for driving the equipment be mounted on the same concrete foundation as the welder. The weight of the machine, without the "Oilgear" equipment or motor, is approximately 7000 pounds.

UNIVERSAL STANDARDIZED BUSHINGS

Drill and reamer bushings and bushing liners of eighteen different body sizes are manufactured by



Examples of a Line of Octagon-head Jig Bushings and Liners Made by the Universal Engineering Co.

the Universal Engineering Co., Frankenmuth, Mich. The view at the left in the illustration shows a bushing of the octagon-head type, and that at the right, a bushing liner. Knurled-head bushings are also included in the line. The smallest bushing of both types is intended for a No. 55 drill, while the largest octagon-head bushing has a 2-inch hole, and the maximum-size knurled-head bushing, a 2 1/4-inch hole. The various sizes are made in from four to six lengths, which eliminates the necessity of making special lengths.

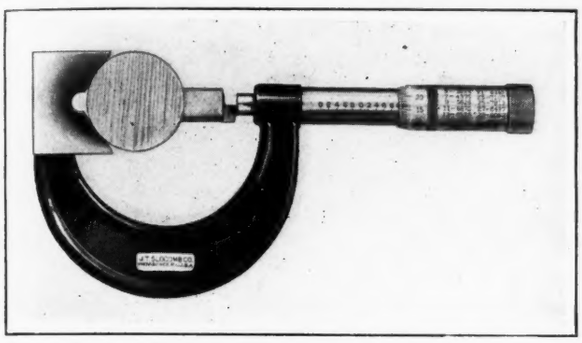
One of the advantages of the octagon-head bushing is that it may be easily removed for replacement, even though rusted to a liner. After being inserted in a liner, it is locked by imparting a one-eighth turn to it. In releasing it, a one-eighth turn automatically raises the bushing, so that no tools are necessary for removing it. The knurled-head bushings are intended for use in multiple operations, as they can be readily inserted or removed by the operator. They have the same locking action as the octagon-head type and are fully interchangeable.

The ball of the bushing liner locks the bushing to the jig plate. Although the liner is a slip fit in the jig plate, the bushing will not turn. Advantages mentioned for the locking action of the liner include elimination of liner distortion and of the necessity of lapping liners. Bell-mouthed liners, out-of-round holes, and loose bushings are obviated.

SLOCOMB MICROMETER FOR SETTING FLY CUTTERS

A micrometer provided with an integral V-shaped anvil, as illustrated, which facilitates the seating of cylindrical bars, is a recent product of the J. T. Slocomb Co., Providence, R. I. This No. 50 micrometer is particularly useful in obtaining the

correct measurement of fly cutters prior to boring operations. The micrometer gives directly the diameter of the hole that will be produced by a fly cutter as set when measured. For instance, if a fly cutter is adjusted outward 0.0005 inch after a measurement, the reading will increase 0.001 inch. This system of reading is obtained by graduating



Slocomb Micrometer Designed to Facilitate the Setting of Fly Cutters

the thimble 0.001 inch for each spindle movement of 0.0005 inch. The micrometer is furnished to suit the diameter of boring-bar used.

MILLHOLLAND SPECIAL AUTOMATIC DRILLING MACHINE

Seven malleable-iron castings of different sizes are handled with one adjustable fixture in a machine recently built by the Millholland Sales & Engineering Co., 1833 Ludlow Ave., Indianapolis, Ind., to meet the requirements of an agricultural implement manufacturer. Four holes of similar size are drilled and spot-faced in each piece by means of four automatic drill head units, which are controlled by compressed air valves. These valves are arranged at the front of the bed, as shown in the accompanying illustration.

Difficulties were encountered in designing this machine, not only because of the fact that there were seven different parts to be machined with the same equipment, but because on one end of the parts are two holes intersecting at an angle of 45 degrees. Some of the parts are left-hand and others right-hand. Also, the parts vary in length as much as 6 inches. The work-holding fixture developed accommodates all parts, whether short, long, right-hand or left-hand.

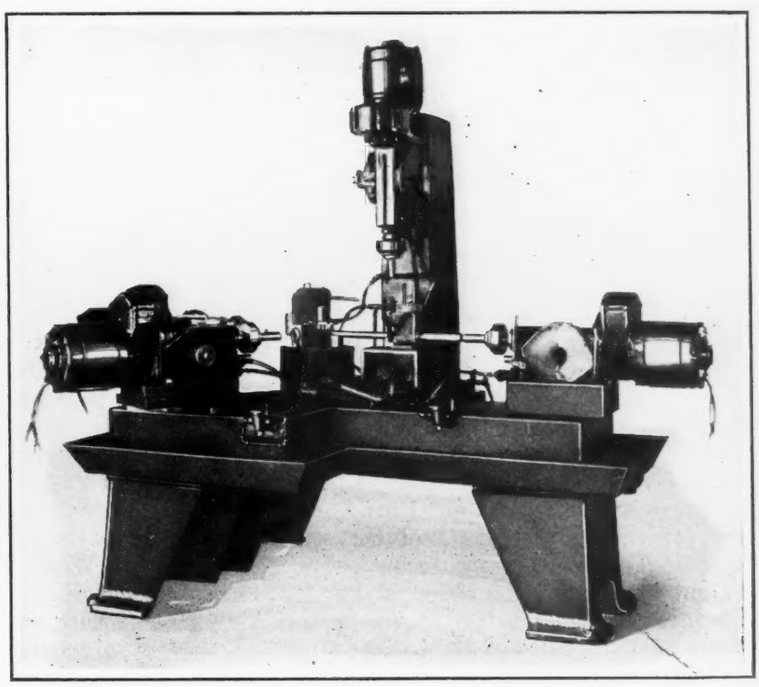
The end of the parts having the 45-degree intersecting holes was taken care of by arranging two drill-head units in saddles that are doweled and bolted to a swivel-plate. This swivel-plate also carries a Y-shaped bushing block and a quick-acting clamp. By swiveling the plate, either right- or left-hand ends of parts can be machined.

To compensate for variations in the length of the work pieces, the swivel-plate is mounted on a false table, which is located on the center line of the machine by means of a large key that slides in a keyway cut into the bed proper. This false table is adjusted in and out by turning a handwheel, and is located at the proper distance from the vertical-spindle center line by means of a dowel-pin and bolts. In sliding the false table in or out, the angular heads and the angular bushing block remain in the correct relation.

Directly under the vertical spindle there is a screw-type drill bushing, which is also used for clamping one end of the work pieces. This bushing has an Acme thread, and a pinion is pressed on the bushing. The pinion meshes with a gear having two heavy pins in its upper face, which provide for applying a hand lever. By rotating the gear, the bushing is revolved to clamp or unclamp the work.

Owing to the fact that the holes in each end of the work intersect, it was necessary to arrange the air controls of the drill units to insure correct sequence of the operation. Thus the two valves are purposely spaced at the operator's right hand and left hand, respectively, so that he will not become confused.

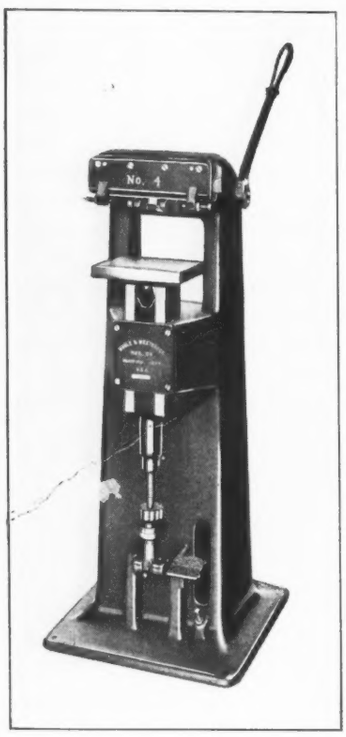
The drill-head units are entirely independent of each other, having separate driving motors. They are of the same construction as the units described in June, 1927, MACHINERY, page 795. The tools are combination-type drills and spot facers. Feeding of the tools is accomplished through a plate cam. A drill feed of 0.015 inch per revolution and a spot facing feed of 0.005 inch per revolution, are provided. A Tuthill motor-driven pump supplies an ample flood of compound. This machine saves three operators over the former methods employed. A further saving is effected owing to the fact that with the previous methods, each piece required a separate group of machines operated intermittently. Obviously, the floor space formerly required for the operations has also been greatly reduced.



Millholland Drilling Machine with Four Individually Driven Drill-head Units

NOBLE & WESTBROOK GENERAL-PURPOSE HAND-OPERATED MARKING MACHINE

A general-purpose hand-operated marking machine of new design, which is designated as the No. 4 model, has been brought out by the Noble & Westbrook Mfg. Co., 20 Westbrook St., East Hartford, Conn., to replace the No. 3 machine which has been made by the company for a number of years. The principal features of the new model are greater ease of operation and greater capacity. It is designed to mark names, monograms, trademarks, letters, numbers, etc., on flat or round metal parts of various sizes and shapes by employing steel marking dies. As in the previous model, the parts to be marked are held in a fixture of suitable design fastened to the table.



Noble & Westbrook General-purpose Marking Machine

The frame of the No. 4 machine is heavier than that of the previous model, and there are no projecting parts in the way of the operator. The latter stands or sits directly in front of the machine instead of at the side. This change makes settings of the machine easier and tends toward quicker feeding of the work. The operator can more conveniently put work on the fixture and watch the movement of the die.

Operation is effected by depressing the foot-treadle to bring the work into contact with the marking die, and then pulling the handle down to move the die across the part. The slide of the machine is ordinarily made to give a mark 4 1/2 inches long, but it can be made to produce marks up to 6 inches long. The slide is fitted with roller bearings to reduce friction. Easily adjustable stops for controlling the length of the stroke are provided. The table is accurately set to the proper height by turning a graduated handwheel, which permits the table to be raised in increments of 0.001 inch.

The roll die-holder is a separate unit of new construction, which is inserted in a dovetail slot in the machine above the table. An adjusting screw makes it easy to change the position of the die-holder from front to back, which saves moving the work-holder. The die-holder can be removed from the machine without lowering the table. Both round and flat marking dies can be furnished, fitted in part with changeable steel type, or a holder made especially to take changeable steel type can be supplied. This machine weighs about 425 pounds, and occupies a floor space of 20 by 20 inches.

"MICRO-POISE" AUTOMOBILE-WHEEL BALANCING MACHINE

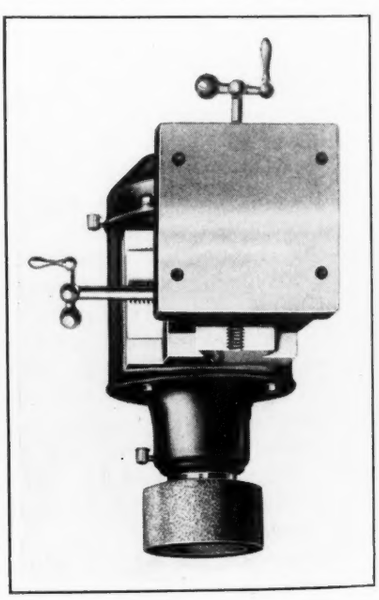
A machine designed for balancing automobile wheel tires and rims has been brought out by the Commerce Pattern Foundry & Machine Co., 2211 Grand River Ave., Detroit, Mich. After the work to be balanced has been placed on this "Micro-Poise" machine, an operating lever is moved, and a universal level then instantly shows the angle of unbalance. Weights are placed on the rim to compensate for the amount of unbalance, and the size and location of these weights are next marked on the tire. The wheel is finally removed and the proper weight attached. Owing to the fact that a limited number of holes are provided for attaching the weights, it is sometimes necessary to attach more than one weight at certain points. The machine is peculiarly adapted for this practice. A production of sixty wheels per hour can be obtained.

"Micro-Poise" Balancing Machine for Automobile Wheels

HISEY VERTICAL-SPINDLE GRINDERS

Three new types of vertical-spindle grinders have recently been placed on the market by the Hisey-Wolf Machine Co., Cincinnati, Ohio. The illustration shows one of these grinders with a double slide adjustment. The other two types have a single horizontal slide adjustment and a single vertical slide adjustment, respectively. All three grinders are made in 1-, 2- and 5-horsepower sizes for alternating current, and in a 3-horsepower size for direct current.

When used in connection with a boring mill, many internal and surface grinding operations can be performed at one setting. The grinders are designed for both tool-room and general-production use. Their bearings are constantly lubricated by an oil bath.



Hisey Vertical-spindle Grinder

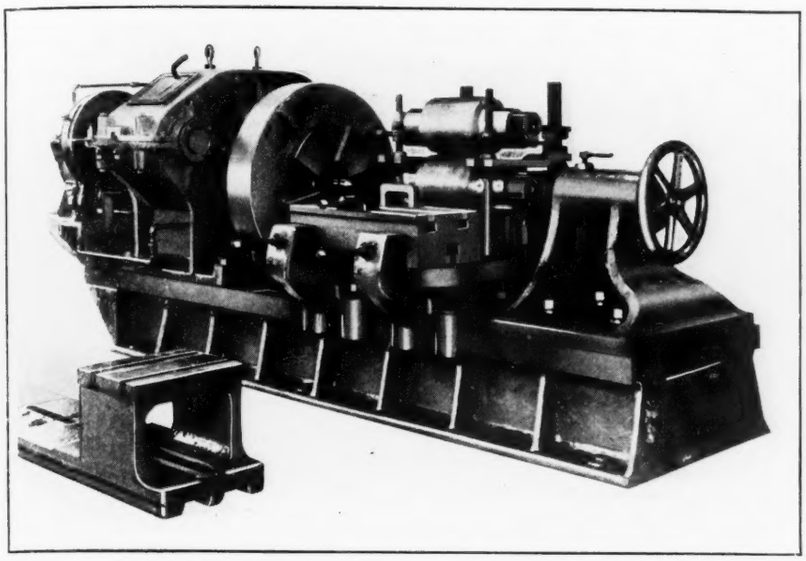


Fig. 1. Mackintosh-Hemphill Heavy-duty Roller-bearing Roll Lathe

MACKINTOSH-HEMPHILL ROLLER-BEARING ROLL LATHES

Two direct motor-driven heavy-duty roll lathes equipped with roller bearings on all gear shafts have recently been produced by the Mackintosh-Hemphill Co., Pittsburgh, Pa. Among the advantages claimed for the roller bearings are minimum friction, minimum attention required on the part of the operator, alignment of gears at all times, elimination of chatter, lessened wear, improved lubrication of moving parts, and a fool-proof drive.

The 31-inch lathe shown in Fig. 1 is designed for operation at speeds ranging from 0.73 to 6.5 revolutions per minute. It is equipped with a totally enclosed headstock in which the gears dip in a bath of oil. Spray lubrication is also provided.

The headstock of the lathe illustrated in Fig. 2 is provided with oil-spray lubrication for the gear teeth and pressure-grease lubrication for the bearings. The motor of this lathe is mounted directly on the headstock and is connected to the headstock drive through a flexible coupling. This lathe is capable of turning two rolls, each 8 feet 6 inches long by 36 inches maximum diameter.

BRAKE-DRUM TURNING AND HONING LATHE

A brake-drum turning and honing lathe designed to meet the requirements of automobile service shops and garages has been developed by the Reed-Prentice Corporation, Worcester, Mass. This machine is shown in the illustration (see next page) arranged for machining brake-drums attached to passenger car wheels. For machining the brake-drums of truck wheels, an outboard support mounted on a steel floor-plate is furnished to take care of the increased weight. Arbors, bushings, etc., are supplied for various sizes and types of wheels. Brake-drums can be turned and honed without removing the tire or rim.

The machine is constructed with a pedestal base. The work-holding spindle is equipped with Timken tapered roller bearings, and is driven through worm-gearing which runs in oil. Power is supplied by a 1/2-horsepower motor operated by 50- or 60-cycle, single-phase, 110- or 220-volt alternating current, or by 115- or 230-volt direct current. The tool-slide is connected through worm-gearing to a 1/12-horsepower motor which operates on the same voltages as the drive motor. This motor is connected with a tumbler switch, which automatically controls the feed of the tool-slide through an adjustable rod, the tumbler switch controlling both the drive and feed motors. Passenger-car or truck wheels are mounted on the machine by means of an arbor which fits a taper hole in the spindle. The spindle is threaded in order to accommodate a draw-bar.

The machine may be equipped with a honing tool consisting of a bar which is fitted to the tool-block the same as the turning-tool bar, but which holds two honing stones. This attachment is used when a better finish is required than can be obtained by turning, although in the majority of cases, a turned

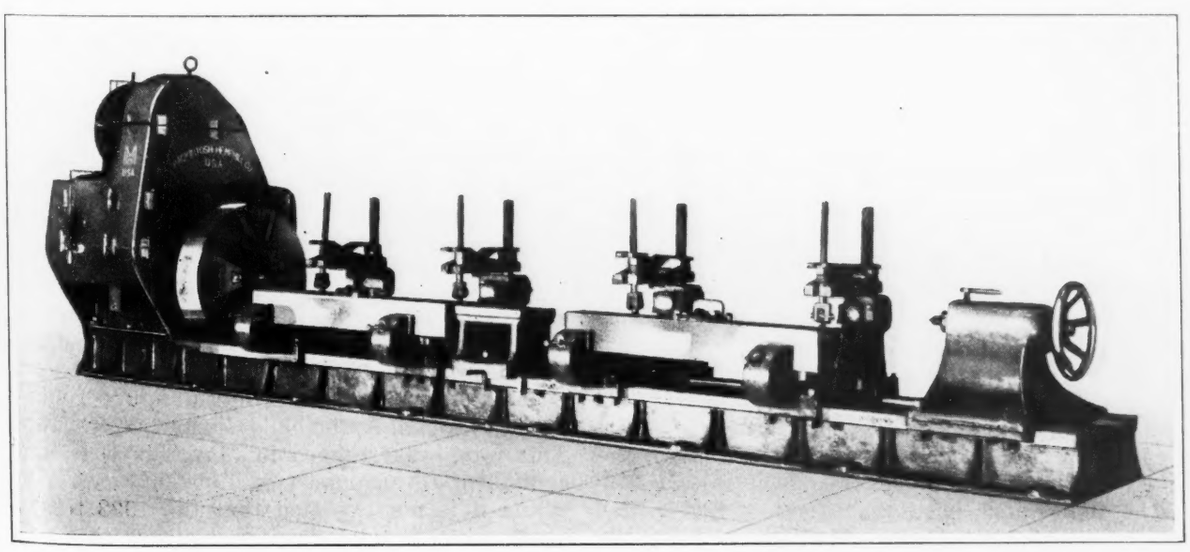
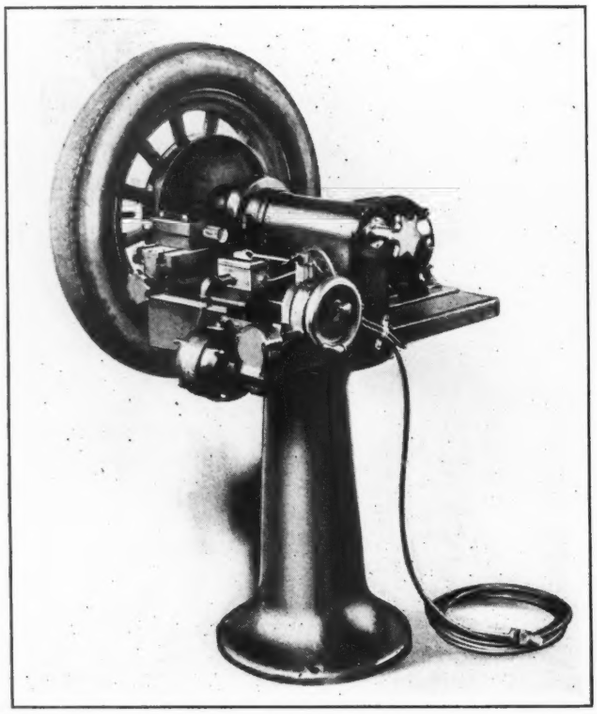


Fig. 2. Lathe which will Simultaneously Turn Two Rolls Each 8 Feet 6 Inches Long by 36 Inches in Diameter



Reed-Prentice Turning and Honing Lathe for Automobile Brake-drums

drum is entirely satisfactory. The honing attachment is constructed to take care of both the outside and inside of drums.

* * *

RAILWAY SHOP REQUIREMENTS DEMAND EFFICIENT TOOLS

By W. R. MILLICAN, Vice-president, American Railway Tool Foremen's Association

Modern production requirements demand the utmost efficiency of available tool equipment. Changes in design and in production methods necessitate constant improvement in tools and equipment. New problems arise from day to day which tax the ingenuity and ability of the production manager and tool designer. The solution of a particularly troublesome problem is occasionally found by the introduction or practical application of an entirely new method. An interchange of knowledge gained by such experience, through the medium of technical magazines, such as MACHINERY, and also at conventions like that of the Railway Tool Foremen's Association results in great benefit to the industry.

We all know that idle machines are a source of expense and that if they are not operated at maximum efficiency the production costs are unnecessarily high. Often the machines do not even pay for the space they occupy. The function of a machine tool is to drive a piece of work past a tool which cuts or forms the work to shape. The cutting tool may be comparatively small in size, but its efficiency is a very large factor in determining the machining cost. Unless the most efficient tool equipment available is employed, a shop must operate at a great disadvantage, as compared with one in which the tool equipment is kept up to date.

The importance of giving the tool and cutter equipment careful attention is indicated by the saving in production time which resulted from the installation of improved equipment in one railway shop. On making investigations, it was found that the floor-to-floor time for machining tank hose nuts was 30 minutes. After careful consideration of the requirements, special tools were made for machining the nuts on a turret lathe. As a result of this improvement in the tool equipment, the nuts are now produced in 3 minutes, floor-to-floor time. In addition to the time saved, the nuts are all machined exactly alike and are interchangeable. The set-up for this work consists of a piloted boring-bar, a piloted counterboring-bar, and a collapsible tap for threading.

Improvements in the machining time on wrist-pin nuts, crankpin nuts, and grease cup bushings were effected by employing practically the same set-up as for the tank nuts. With the old method, the machining time for wrist-pin nuts was 32 minutes, while with the new method, the floor-to-floor time is only 10 minutes.

The cutting time required for the removal of flues was reduced approximately one-third by designing a special machine to handle this kind of work. In addition to increasing the amount of work handled, the special flue-cutting machine also reduced the amount of power required. In machining the inside jaws of universal joints for injector rods by the old method, the work was held in a regular vise, one piece being machined at a time. By building a suitable fixture, it was possible to machine these parts on a high-production basis. The continuous milling fixture employed in this case was designed to permit the parts to be removed and replaced while the machine was in operation. The continuously revolving fixture was secured to the rotary table of the milling machine. In operation, the parts revolve past a milling cutter which machines the inside of the jaws, after which the jaws are removed and replaced by new work. The milling cutter was mounted on a stub arbor secured to the vertical head of the machine.

Many parts now handled on machines equipped with out-of-date tools could be produced at greatly reduced costs by providing up-to-date equipment, obtainable at comparatively slight expense. Although the machine tool may weigh tons, where the cutting tool only weighs pounds, it is the small tool that ultimately determines the value of the equipment. Obviously, then, the cutting tools should be as carefully selected as the machine.

Those responsible for production must keep informed on the developments in machining methods. This requires careful study of all new machines and tools. Better machines and better tools are constantly being developed which will save their original cost in a comparatively short time.

* * *

For the first time in automotive history, purchases of automobiles of American manufacture outside the United States have reached a total of 86,000 in one month, according to figures published by the National Automobile Chamber of Commerce. This total was reached in May this year, and is equivalent to an export of 1,000,000 cars a year. While it is not expected that the 1928 total will reach the million-mark, it is believed that in two or three years this export figure will be attained.

VANADIUM STEEL DEVELOPMENT

By BAXERES de ALZUGARAY

The comment appearing on page 905 of August MACHINERY is somewhat inaccurate in its reference to vanadium steel. The statement is as follows: "Many of the alloy steels have been known only about thirty years, or less; vanadium steel, for example, has been known as an alloy steel since 1896, when Helouis, a French investigator, published results of testing certain vanadium alloy steels."

In 1879, the writer produced vanadium and vanadium alloys from Spanish ores and others in the laboratory and works of Torrens & Co., Victoria Park, London. This work was continued intermittently until 1884. In 1890-1891, alloy steels with vanadium and other elements were produced by the writer in his own London laboratory; a number of patents covering the manufacture of ferro-alloys were applied for in 1890 and later, anticipating by nearly two years the publications of Henry Moissan on the reduction of refractory metals—vanadium and its alloys among them—in the electric furnace. Aluminum-thermic process of reduction of vanadium and other oxides was also tried, but abandoned for the more economical electric reduction. The latter tests were made seventeen years before the experiments of Helouis.

The first vanadium and ferro-vanadium works ever established for the industrial production of vanadium and its alloys were built and operated under the writer's direction in 1897 at Llanelly, South Wales, England. Ferro-vanadium from the Llanelly Works was imported into the United States until 1904. During the years 1904-1908 the vanadium industry was started in the United States under the technical guidance of the writer.

* * *

HYDROGEN COOLING SYSTEM INCREASES CAPACITY OF ELECTRICAL EQUIPMENT

Hydrogen gas within a totally enclosed rotating machine is used in a new cooling system for electrical apparatus which has been brought out by the General Electric Co., Schenectady, N. Y. The principal advantage claimed for this cooling system is that it permits the same size of electrical equipment to handle up to 50 per cent more power than would otherwise be possible. This increase in capacity is obtained without increasing the operating temperature beyond the point of safety.

The first commercial application of the new system has been made in connection with a synchronous condenser installed at the Pawtucket, R. I., substation of the New England Power Co. If this condenser were air-cooled, it would have a capacity of 10,000 kilovolt-amperes, but by having it hydrogen-cooled, the condenser capacity has been increased to 12,500 kilovolt-amperes.

Hydrogen cooling also has other advantages. Not only is the capacity of the apparatus increased, but oxygen and dirt are excluded. Hydrogen will not support combustion, and fires of any kind are consequently impossible, even from short circuits. The usual air-cooled apparatus must be placed within a building, but hydrogen-cooled equipment, being totally enclosed, can be placed outdoors.

THE TELEPHOTOGRAPH MAKES QUICK DELIVERIES POSSIBLE

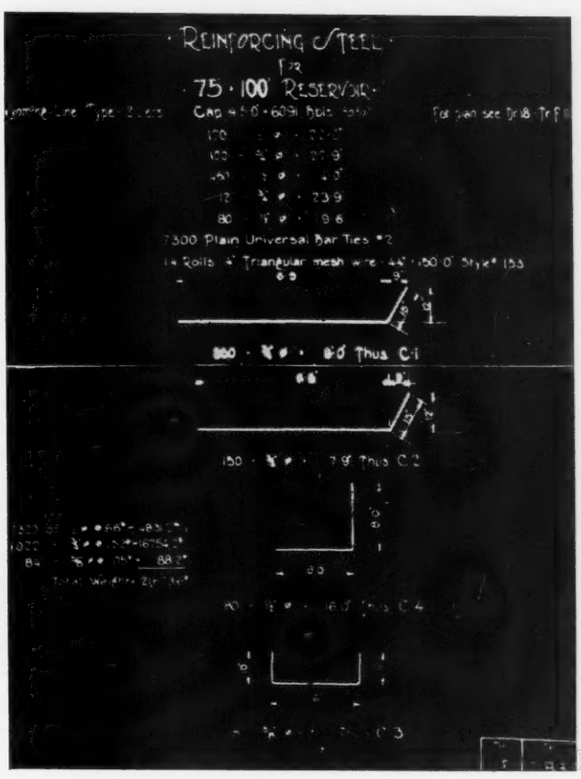
A practical application of the telephotograph or "picture-by-wire" service of the American Telephone & Telegraph Co. in industry was recently made by the Sinclair Pipe Line Co., Tulsa, Okla., when it was confronted by the urgent need of reinforcing material for a large reservoir being constructed at La Rose, Ill. An order for the material, which included 1890 reinforcing bars with 1100 bends, 7300 bar ties, and 14 rolls of wire mesh, was placed with the St. Louis representative of Joseph T. Ryerson & Son, Inc., in the forenoon of July 24. It was requested that the quickest possible action be taken.

As the order was in the form of a blueprint showing sketches of the bends, etc., it could not be transmitted by telephone to the Ryerson plant at Chicago, from which the material could be delivered most quickly. Therefore, the order was telephotographed from St. Louis to the Chicago plant, where it was received at 3:30 o'clock on the afternoon of the same day, together with a telegram giving billing and shipping instructions.

Upon its receipt at the Chicago plant, the order was written up in the usual manner, issued to the shop, and in less than 1 1/2 hours the material was ready for shipment. It reached La Rose at 4:20 A. M. on the following day, greatly expedited by means of the telephotograph. Since the telephotograph was a direct copy of the blueprint, showing the material desired, mistakes in the transmission of the order were impossible.

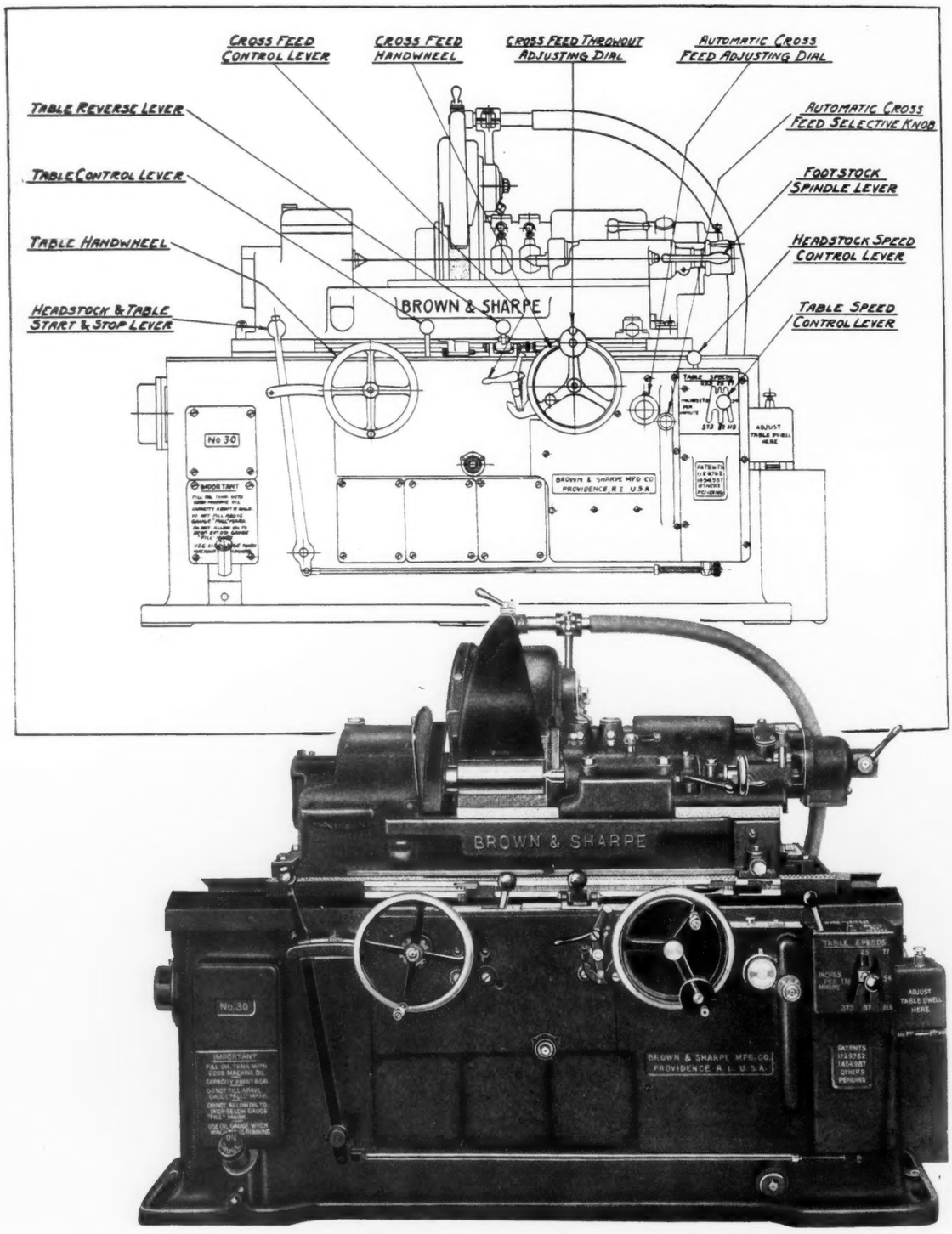
* * *

The automobile industry consumes 29 per cent of all the nickel used in the United States.



Facsimile of a Telephotograph which Hastened the Delivery of Supplies

SIMPLIFIED CONTROL *and* U



UNUSUAL FLEXIBILITY

save the Operator's time on the New Brown & Sharpe Plain Grinding Machines

IN DESIGNING the New Plain Grinding Machines the convenience of the operator was kept continually in mind. All operating controls are simplified and grouped at the front where they are easily reached from the normal operating position.

Changes in the speed of work and table are quickly and quietly made, in each case with a single lever, while the machine is running. These speeds are positive, being mechanically obtained through sliding gears. A wide range is provided; 9 table speeds, from 17" to 373" per minute and 6 work speeds, from 42 to 270 R.P.M.

The simplicity of the table and work speed controls illustrates the facility of operation that is an important time-saving feature of the New Plain Grinding Machines. Write for the illustrated booklet describing the many other advanced features of these machines. Complete specifications of any particular size in which you are interested will be included with the booklet at your request.

The New
BROWN & SHARPE
Plain
Grinding Machines

No. 30 (12"x18")
No. 32 (12"x36")
No. 33 (12"x48")
No. 35 (12"x72")

MODIFIED MACHINES

Nos. 30A, 32A, and 33A
(Power Table Feed for Wheel Truing and Power Cross Feed)

Nos. 30B, 32B, and 33B
(Hand Table and Cross Feeds)

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

The Machining of "Bakelite Laminated"

"BAKELITE laminated" is the name given to one of the Bakelite products used in industry to a very large extent. It is produced by a number of companies under a special license from the Bakelite Corporation and is known under different trade names according to the company by which it is manufactured, the trade names being Micarta, Formica, Dilecto, Phenolite, Spaulding Bakelite, Textolite, and Fibroc. All of these products, however, have similar characteristics, and in the present article will all be referred to simply as "Bakelite laminated."

Briefly described, the laminated material is manufactured as follows: A resin-like product—or resinoid as it is more correctly called—which is the basis of several phenol-resin materials sold under the trade name Bakelite, results from the interaction of formaldehyde and phenol. For the manufacture of Bakelite laminated, this resinoid is dissolved to provide a varnish which is then used to impregnate the laminating fabric, which may be either paper or cloth.

After being so impregnated and the solvent dried off, the processed web of paper or cloth is cut into sheets of convenient size. A large number of these sheets are then superimposed and placed in a hydraulic press, and under the action of heat and pressure a hard, dense, rigid plate is produced. While both paper, linen and canvas stock may be used, it is the practice to use canvas for service requiring maximum shock resistance. The material made from canvas is fabricated into gears to a very large extent. Such gears, although resilient, are strong enough to have self-supporting teeth and, except where conditions of heavy starting torque are encountered, they require no side plates or shrouds.

The gear manufacturer receives his gear stock in the form of large sheets, which are then sawed into blanks of the approximate gear diameter desired. The resulting disks are then turned, bored and made ready for the cutting of the teeth much the same as would be metal blanks. The following information relating to the machining of Bakelite laminated has been compiled by the Bakelite Corporation.

Machining Bakelite Laminated

Successful machining of this material chiefly depends upon keeping the tools sharp and operating them at the proper speed. Milling cutters, saws, drills, etc., will not give satisfactory results unless kept in a very good condition. It is sometimes necessary to resharpen them every thirty minutes. The tools operate best at high speeds—from 1500 to 2500 revolutions per minute, except when the cut is so large that it would overheat the tool at these speeds, as for instance, in drilling holes 1 inch or larger in diameter.

For sawing Bakelite laminated, band saws should be kept sharp and should be frequently reset. Circular saws should be made of hard steel, just soft enough to be touched with a file. If extremely smooth edges are required, the saws should be hollow ground and used without set. In stocks of certain grades and thickness a band saw will cut effectively for two hours, while a circular saw will need resharpening every twenty minutes. Where a large amount of sawing is done, a filing machine for each saw bench will be found a great convenience and time-saver.

For straight cuts a band saw width of 1 inch is most desirable—for scroll work, 1/4-inch width. The usual band saw should run at about 4000 linear feet per minute.

The circular saws used are generally 10 inches in diameter, working at 2500 revolutions per minute on stock 1 inch or less in thickness. For greater thicknesses, saws up to 16 inches in diameter are employed, the latter running at 1500 revolutions per minute. For all-around use, a 14-inch saw ranging in thickness from 1/8 to 5/32 inch, with 110 to 120 teeth, and running at a speed of 2500 revolutions per minute, is recommended.

Planing and Milling

In planing Bakelite laminated a high speed and coarse feed should be used. The depth of the cut should not be less than 1/16 inch. For milling cutters high speed and coarse feed should be employed. Whenever possible it is advisable to remove all the material that is to be removed in one cut. The use of a cooling compound will prevent the burning of the tools, but is not always necessary.

Turning and Drilling

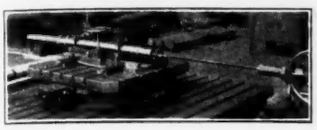
When turning Bakelite laminated, about the same methods as for turning cast iron may be used, but the turning speed may be 25 per cent higher. The tools should be ground to a diamond point having plenty of clearance, but with 3 to 5 degrees more rake than is common for metal.

Whenever possible, the work should be turned to size in one cut, but if two cuts are required, the second cut should remove at least 1/8 inch, as there is difficulty in maintaining a uniform diameter when a lighter cut is taken.

For drilling, use high-carbon steel drills without lubricant. When drilled with a properly ground drill, the hole will be true and straight, but about 0.003 inch under size. To prevent excessive heating, the drill should be withdrawn quickly. To obtain a hole of the same diameter as the drill, the latter should be ground slightly off center. The drill needs to be reground about once every 30 minutes.

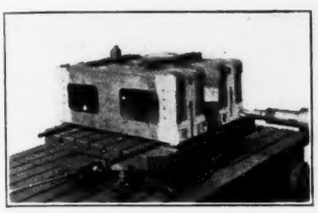
The best results are obtained by running the drills at the highest speed that can be used without burning the tool. The drill should not be forced into the material; if kept sharp it will require but slight pressure for feeding into the stock. When drilling holes 3/16 inch in diameter and under, it

TYPICAL PERFORMANCE



Drilling Jack Shaft

A number 1, Ryerson Horizontal drilling a 1" hole, 36" deep and a 1" hole 15" deep in Hyten steel 45 carbon. Jack shaft weighing 225 pounds mounted on turntable with special automatic jig for quick movement of shaft.



Drilled From Four Positions—One Set-up

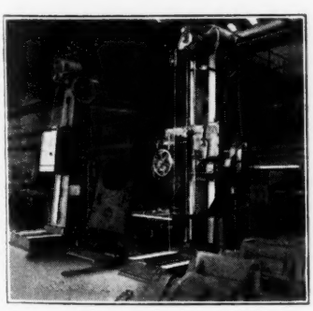
Two castings 12" x 18" x 4' weighing 450 pounds mounted on a 4 foot revolving table. Drilled from four positions with the one set-up.

Four 1¾" holes drilled through 1" material.

Two 1¾" holes drilled and reamed through ½" material.

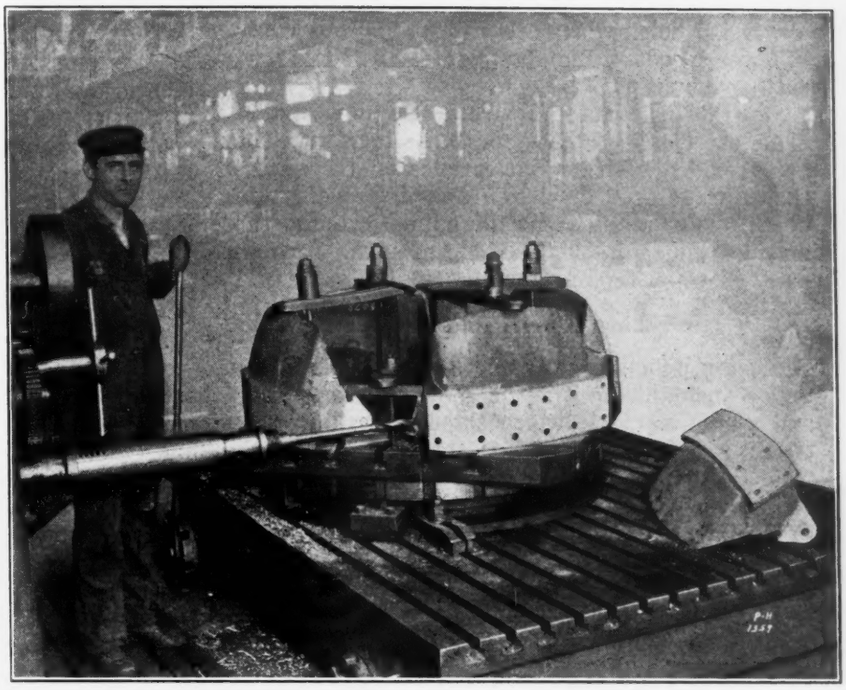
Eight 11/16" holes drilled through ⅝" material.

Floor to Floor Time, 1½ hours for two pieces.



A Very Accurate Job

Two number 12 Ryerson Horizontal Drilling and Boring Machines at work on a gun carriage at the Watertown Arsenal, Watertown, New York. Drilling, boring, facing and tapping carriage parts.



20 Buckets—14¼ Hrs.

Every Pair of Holes at a Different Angle

This job is typical of the time and labor that are saved by a Ryerson Horizontal Drill.

Four ditcher buckets, each weighing eighty-five pounds, were mounted on a 4 foot turntable and each drilled from eight positions with the one clamping. Twelve 13/16" holes were drilled through 1⅛" material and two 1" holes through ¾" material in each bucket. Twenty buckets were handled in 14¼ hours, floor to floor time.

All jobs—small pieces on a production schedule or the largest castings—can be economically handled on a Ryerson Horizontal. Let us send you the facts.

Write for Bulletin 4051

JOSEPH T. RYERSON & SON INC.

ESTABLISHED 1842

Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Pittsburgh, Philadelphia, Boston, Jersey City, New York, Richmond, Dallas, Tulsa, Los Angeles, San Francisco, Denver, Minneapolis, Duluth

Drill it Horizontally

is recommended that no cutting lubricant be used. For larger holes, which are drilled at proportionately lower speeds, it may be found desirable to use a cutting lubricant.

Several drill manufacturers are now making drills especially designed for Bakelite work. They are provided with extra clearance on the edge of the flutes to reduce friction and to prevent overheating. For tapping and threading, ordinary taps and dies are suitable, a lubricant being used the same as when tapping metal.

Punching, Shaving and Shearing

A plain punch and die may be used on stock up to 1/8 inch thick. The die should be kept sharp and a minimum clearance should be allowed between punch and die. For the best results the material should be heated thoroughly and uniformly in an oven to a temperature of 280 degrees F. Frequently a steam heated table is located beside the punch operator.

Stock between 1/8 inch and 3/8 inch in thickness should first be blanked and then finished in a shaving die. The work should be heated in oil and the edges of the shaving cutter should have a slant of about 45 degrees. The shaving operation mentioned is not recommended for preparing disks from heavy stock, as it is preferable that they be sawed and then turned in a lathe. The shaving operation on thick stock has a tendency to "delaminate" the layers and thereby weaken the structure.

When Bakelite laminated has to be sheared it should be heated to a temperature of from 120 to 300 degrees F., depending upon the grade of the material, to prevent checking at the edge. Since there is difficulty in holding the heat in thin stock during the transfer from heating plate to press, it is well to have these two devices close together.

Producing Bakelite Surface Finish

A dull surface finish for ornamental purposes can be obtained by rubbing with pumice stone cloth and finishing with oil. A dull mat finish can be secured by rubbing with a No. 0 emery cloth and finishing with a No. 00 emery cloth. The use of sandpaper in place of emery or Carborundum is recommended for radio parts, because of the fact that particles of emery may adhere and affect the electrical properties.

* * *

An interesting process has been developed by Dr. Ing. Joosten of Berlin, Germany, for transforming loose sand and earth into a hard material sufficiently strong for the foundations of buildings. This is done by injecting certain chemicals into the ground. A new building at Spandau, near Berlin, has been erected on such a foundation.

Grease as a Lubricant

A consulting engineer on lubrication problems is frequently asked whether to use grease or oil as a lubricant for a particular machine or bearing. His usual reply is: "Don't use grease if oil can be used just as conveniently." This, however, does not mean that there are not a great many places where grease is more advantageous than oil. The type of lubrication to employ, therefore, must be determined from the operating point of view, and many factors must be considered. In the article "Where and When to Use Grease as a Lubricant," to be published in October MACHINERY, H. L. Kauffman, consulting petroleum chemist and lubricating engineer, gives definite directions as to when to use grease as a lubricant—information that is not readily available elsewhere.

STANDARD TEMPERATURE FOR END GAGES

The Seventh General Conference on Weights and Measures passed a resolution directing the appointment of a committee to consider the question of the "temperature of definition" of end standards. The committee appointed consists of members of the English, French, German, and American Bureaus of Standards, and the director of the International Bureau of Weights and Measures.

In order to obtain a consensus of engineering and industrial opinion in the United States, the Bureau of Standards at Washington requested leading American engineering societies and machine and tool manufacturers to express their ideas on the subject. Statements have now been received from nearly all of these organizations and companies, and the opinion is unanimously in favor of 20 degrees C. (68 degrees F.) as the temperature at which industrial standards of length, including end gages, should have their correct nominal length.

The reasons set forth are substantially the same in all cases and may be summarized as follows: (1) Industrial standards of length should have their correct nominal length at a temperature as close as practicable to that at which they are used; (2) 20 degrees C. (68 degrees F.) represents the actual temperature of laboratories and shops in the United States in which end gages are used; (3) 20 degrees C. is in practically universal use in the United States as the standard temperature for industrial standards of length; (4) 20 degrees C. is more widely used as a standard temperature for length standards than any other single temperature, the only important exceptions being the use of 62 degrees F. in England, and 0 degrees C. in France; (5) 20 degrees C. has less opposition, and, therefore, greater chance of universal adoption than any other temperature; (6) the alternative plan of adopting 0 degrees C. as the standard temperature for industrial end gages is open to serious objection because its adoption would necessitate the introduction of unnecessary difficulties and uncertainties in the comparison and use of standards.

* * *

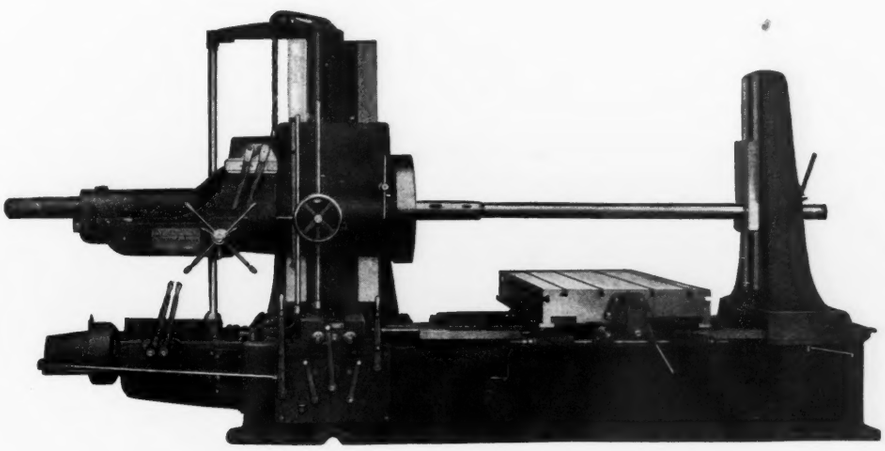
Stellite has recently been applied to oil-well drilling tools. The Department of Petroleum and Gas of the California State Mining Bureau reports on this application as follows: "Stellite-finished bits have been tried in competition with steel bits of highest quality. A bit with stellite properly applied will make about three times as much hole per run as an all-steel bit. The resulting economy is greatest in deep holes, due to the reduction in time incident to changing bits. An additional saving is due to the fact that the stellite bit may be fed at a greater rate of speed than the all-steel bit."

An Excellent Overflow Machine

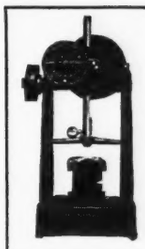
As your boring, milling and drilling departments become crowded, from time to time, take care of the peak load in all of them, successively and successfully with a LUCAS

"PRECISION"

Boring, Drilling and Milling Machine



Holes may be bored and surfaces milled at a single setting and their accurate relation assured, without the necessity of expensive jigs.



WE ALSO MAKE THE

LUCAS POWER Forcing Press

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U.S.A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo, Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy.

THE MANUFACTURE OF MACHINISTS' HAMMERS

By DONALD A. HAMPSON

For more than half a century Maydole hammers have been on the market. The business was started at Norwich, N. Y., by David Maydole, a blacksmith, when he forged out a few hammers for a crew of itinerant workmen. The methods in vogue today present some interesting combinations of traditional practice with modern developments.

All the hammer heads are press forgings. This method is employed, because it allows a lower heat to be used for the work; and the company believes that there is less shock to the steel when forgings are made in this way. The forging punches are carried on the ram of the press, and the dies set in a bolster on the bed. From four to six sets of tools are employed on a press, and the heated blank is moved progressively from one to the other. In the first two positions, for example, are punches which produce the eye of the hammer; in the third, a loose punch which sizes the hole; in the fourth, a pair of dies which form the sides while a punch fills the eye; and in the fifth, a pair of dies which shape the heads.

Claw hammers are forged in much the same way. The familiar curved claw is first forged flat, then split, and finally bent to shape while still hot. The faces on all hammers are turned. Grinding them to shape by hand or leaving them as they come from the dies would not meet the requirements. In turning, the hammer head is held stationary in a chuck while revolving tools machine it. This work is done in special machines of heavy construction.

The heat-treatment department shows, in a striking manner, the transition from old methods to new. The hammers are heated in lead pots, which are gas-fired. A dozen or more hammer heads are hung on racks, which are manipulated on a conveyor system with dipping apparatus. The quenching of the hammers takes place while they are still on the racks, as does also the drawing, which consists of immersing the work in a bath of salts at a temperature of 300 to 350 degrees F. Large peen hammers are still heated in hard coal furnaces, but this method, which was formerly used for all hammers, will be superseded as new equipment is installed. The two faces of peen hammers are tempered separately by electric heating apparatus. With this type of equipment, there is a closer control of the work at all times, and less dependence is placed on the skill of the operator.

Some hammers are finished in black and others are nickel-plated, but the majority are polished over the greater part of the head. The Maydole Co. recognizes polishing as a major operation that should be done on high-grade machinery with special wheels, instead of upon makeshift equipment. A completely equipped department cares for the wheels and attends to all cleaning and application of new abrasive.

All hammer handles are of hickory. These are kiln-dried, so that less than 5 per cent of moisture remains. Uniform results are thus secured, and a tight head throughout years of usage is insured. Contrary to a somewhat general notion, kiln-drying does not "kill" a piece of wood, but merely removes moisture from the cells of the wood, which otherwise might gradually come out while the hammer was resting on a shelf in a heated store. Wood expands as much as 10 per cent in a radial direction, a fact that explains why hammer handles may loosen if not correctly prepared. Besides kiln-drying the handles, the wedges that are driven in to secure the head are similarly dried.

The handle itself is a driving fit in the eye of the hammer; it is driven home with a four-pound hammer, and the wedges are applied to the free end. After sawing off the excess wood, the end is sealed to prevent the absorption of moisture. The assemblers have work "benches" that are massive blocks of wood, resembling butchers' blocks. Metal-lined wells in these blocks permit the handles to sink down to a convenient height.

Although Shore and Rockwell hardness tests are made on every head, another test is made which these cannot replace. This is a rebound test, in which a workman strikes the hammer against the polished dome of a hardened anvil, about 2 inches in diameter, set in a large wooden base. From the rebound of the blow on this anvil, the tester is able to discover defects that have escaped the instruments, including that of a head which has not hardened properly all the way through. It is a test in which feeling and hearing combine in a final, critical inspection.

* * *

STANDARDIZATION WITHIN THE SHOP

By FRITZ L. KELLER

To increase efficiency in tool designing, there should be as much standardization within the shop as possible. In larger shops especially, several tool designers may be working on tools which are to be used on similar jobs, and yet, each makes an entirely new and complete design. This may be avoided to a great extent if a tool design manual is prepared, containing the dimensions and specifications covering all tools that are in general use.

The preparation of the tool design manual depends, of course, on the nature of the product to be manufactured. The manual would vary to a great extent in different plants. It should be carefully planned to meet the specific needs of each shop and should not be crowded with useless data.

It is not a good plan to go to the trouble and expense of making such a manual all at one time. It is better to begin by putting into it the best information and drawings of tools that have proved satisfactory. If a complete design is shown, it is well to attach to it a sheet on which the points of importance in the design may be explained. The information given in the manual should not necessarily be confined to that in constant use; but whatever may be of help, on less frequent occasions, should be included.

By having the manual in loose-leaf form, changes can easily be made when new and better ideas are introduced. Each tool designer should be furnished with such a manual, which should also contain instructions as to materials to be used, heat-treatment, the proper place to stamp the tool number, when standard forms of drawings should be used, and other general information.

Wetmore Cylinder Reamer doing its bit to put quality into a six cylinder HALL-SCOTT Motor in Berkeley, Calif., plant.

"We are so well pleased with Wetmore Reamers that we have standardized on them exclusively for cylinder block reaming and preparation for honing."
HALL-SCOTT MOTOR CO.

HALL-SCOTT now use *the* WETMORE *exclusively*

STILL another great motor manufacturer specifies Wetmore Adjustable Cylinder Reamers *exclusively.* Hall-Scott Motors demand the finest in accuracy, the utmost in efficiency and durability.

Wetmore Reamers give Hall-Scott, and many other famous motor plants, unusual durability and sturdiness, plus greater working speed and no vibration.

The Wetmore Roughing reamer is extremely rugged. The left-hand angle blades of the Semi-finishing reamer eliminate chattering and digging in, assuring a straight, round hole with no scoring. The construction of the Finishing reamer assures a smooth, glass-like finish to the cylinder wall.

Wetmore *guarantees* this: a trial in *your* shop, in competition with other reamers, will prove to you that the Wetmore will save you time and money, and give you greater precision.

Write for catalog and prices.

WETMORE REAMER CO.
60 - 27th Street Milwaukee, Wis.

WETMORE ADJUSTABLE REAMERS
"THE BETTER REAMER"

PERSONALS

WILLIAM E. GIFFORD of the Gifford Screw Products Co., Worcester, Mass., has severed his relations with the company.

G. E. RANDLES, president of the Foote-Burt Co., Cleveland, Ohio, has just returned from a two months' trip to Europe.

WILLIAM HUNTER, who, since the first of the year, has been acting manager of the Philadelphia office of the Niles-Bement-Pond Co., was made manager of that office on July 1. Mr. Hunter has been associated with the Niles-Bement-Pond Co. for many years.

E. J. KEARNEY of the Kearney & Trecker Corporation, Milwaukee, Wis., returned to the United States on the *Aquitania* August 11 from a combined business and pleasure trip in several of the European countries, on which he was accompanied by his wife and family.

CHARLES J. ARTHUR has been added to the sales force of the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Mr. Arthur will be located at the Philadelphia office of the company. He was, until recently, sales engineer for the A. R. Amos, Jr., Co. of Philadelphia.

ARTHUR JACKSON, president of the Arthur Jackson Machine Tool Co., Toronto, Montreal, and Vancouver, sailed on August 18 on the steamship *Montroyal* from Montreal to attend the British Machine Tool Exhibition at Olympia, London. During his visit Mr. Jackson also expects to visit a large number of European plants.

J. H. ROTH, who has been connected with the Ball & Roller Bearing Co., Danbury, Conn., for eighteen years, for the last ten years as treasurer, has left the company. He has not yet made any definite plans for the future. Mr. Roth has worked in all departments of the plant, rising, in turn, to superintendent, plant manager, and secretary.

JOSEPH F. FRESE has been elected vice-president and assistant chief engineer of the Monitor Controller Co., Baltimore, Md. Mr. Frese has been connected with this company for about twenty-eight years. Fifteen years ago, he opened the New York office, and through his efforts, the trade in that district has developed to its present proportions.

DR. ROBERT J. ANDERSON, who has been director of research of the Fairmont Mfg. Co., W. Va., maker of aluminum sheet, coil, and other rolled products, has been elected vice-president of the company in charge of production. Dr. Anderson sailed August 1 on the *Aquitania* for an extended business trip abroad. WILLIAM J. LANGE, metallurgist, has been made technical supervisor.

In a personal item in August MACHINERY, on page 968, it was stated that J. W. CLIFF, who has recently become production manager of the MacGregor Valve Co., St. Louis, Mo., had been connected for five years with the Merco Nordstrom Valve Co. as shop superintendent. This statement was in error; Mr. Cliff had no previous connection with the Merco Nordstrom Valve Co.

A. S. GOULD, at a recent meeting of the stockholders and directors of the Oster Mfg. Co., Cleveland, Ohio, manufacturer of pipe threading and cutting machines, was elected secretary of the company. Mr. Gould has been sales manager of the company for ten years and will continue to hold that position. At the same meeting R. B. TEWKSBURY was re-elected president, and Roger Tewksbury, formerly secretary, was elected vice-president and treasurer.

JOHN W. BRAY, sales manager of the Bullard Machine Tool Co., Bridgeport, Conn., sailed on the *Homeric* August 18, in company with Mrs. Bray, for an extensive trip to the British Isles and the Continent. Mr. Bray is combining business with pleasure, and will spend part of his time at the Olympia Machine Tool Exhibit in London, where several Bullard machine tools are being shown. His itinerary will include not only the British Isles, but also the principal business points in Norway and Sweden, Germany, Belgium, Switzerland, and Czecho-Slovakia.

ALFRED V. DE FOREST, research engineer for the American Chain Co., Chicago, Ill., has been awarded the Dudley Medal by the American Society for Testing Materials in recognition of his achievements in developing non-destructive tests for materials. Mr. de Forest's testing device involves the use of a sensitive galvanometer for detecting flaws in metal objects by making use of the magnetic circuit. Mr. de Forest graduated from the Massachusetts Institute of Technology in 1912. Since 1918 he has been chief research engineer for the American Chain Co.

ROBERT THURSTON KENT has been engaged by the Divine Bros. Co., Utica, N. Y., as manager of the sales and engineering departments. Mr. Kent is a graduate of the Stevens Institute of Technology. For many years he has been engaged in consulting engineering work, and lately has been general manager of the Bridgeport Brass Co., Bridgeport, Conn. He has been very active in the affairs of the American Society of Mechanical Engineers, being chairman of the Standing Committee on Professional Division and formerly chairman of the Management Division.

ALEX L. MILTENBERGER, heretofore Pacific Coast manager, with headquarters in San Francisco, of the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo., has been transferred to St. Louis as branch manager of that office. Mr. Miltenberger has been in the employ of the Wagner Electric Corporation since his graduation from Columbia University in 1909. In 1920 he was promoted to the position in San Francisco, which he has held up to the present time. FRED JOHNSON, hitherto in charge of the St. Louis sales office, has been made manager of the Los Angeles branch office. Mr. Johnson has served as district manager of the St. Louis territory for twenty-one years.

CLAUDE HARTFORD has been elected vice-president of the American Elevator & Machine Corporation, with headquarters at 113-115 Cedar St., New York City. Mr. Hartford was formerly manager of the Industrial Relations Department of the New York Steam Corporation. He became associated with that public utility in July, 1913, serving, successively, as assistant to the chief engineer; superintendent of the district embracing the lower portion of Manhattan; and engineer of the contract department. Mr. Hartford received his engineering education at Stevens Institute of Technology and Cornell University, and was graduated from the latter institution in 1910 with the degree of Mechanical Engineer. He is a member of the American Society of Mechanical Engineers.

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MACHINE SHOP PRACTICE MEETING IN CINCINNATI

A joint meeting of the Machine Shop Practice Division of the American Society of Mechanical Engineers, the Cincinnati Section of the society, and the Machine Tool Congress will be held in Cincinnati, Ohio, September 24 to 27, with headquarters at the Hotel Sinton. The meeting will include a river trip from Cincinnati to Ashland, Ky., to inspect the continuous sheet mill plant of the American Rolling Mill Co., leaving Cincinnati Monday afternoon, September 24, and returning Wednesday morning, after which technical sessions will be held at the Hotel Sinton. Two technical sessions will also be held on board ship. The sessions will deal with airplane production problems, lubrication, and a symposium on machine tools in the more important industrial fields, the speakers being prominent industrial executives in the leading machine tool using industries.

* * *

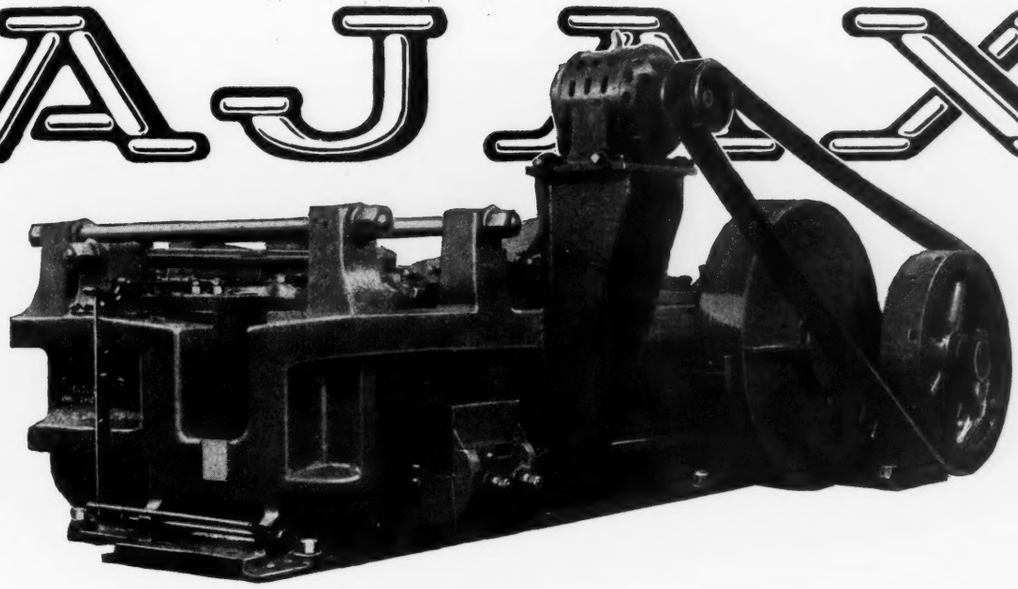
COURSE IN DIESEL ENGINE PRACTICE

In order to meet the demand for information concerning the principles of operation of Diesel engines, the Polytechnic Institute of Brooklyn, New York, offers an evening course in Diesel engine practice. This course was first inaugurated in 1923, and since that time about 400 men have taken the course. This Diesel engine course is not a part of the regular undergraduate work of the institute, but is designed solely for men interested in oil engines, irrespective of their previous education. Twenty two-hour lectures are given during the winter every Tuesday evening. To meet the needs of those who wish to train themselves for operating, building, selling, or designing oil engines, the lecture course is supplemented by class-room exercises and laboratory periods.

* * *

It may be laid down as a fundamental rule, says Cris Berg in an article "How Greater Efficiency May be Obtained," to be published in October MACHINERY, that the outside consulting engineer's ideas are worth only as much as the superintendent and foremen of a plant believe they are worth. If the industrial engineer engaged to increase the efficiency of a plant cannot enlist the confidence and cooperation of the regular organization, it is waste of money to engage his services.

AJAX



What's Your Toughest Upsetting Job?

ONE that takes the life right out of a forging machine and makes her grunt on the final stroke.

Ten to one it's a thin flanging job with no cushion, where the dies and heading tool come "metal to metal." The kind that breaks piston rods on steam hammers and crankshafts on forging machines.

It's flanging jobs that test forging machines and it's Ajax Machines that stand the test. Flanges 5″ in diameter ¼″ thick; 11″ in diameter 1″ thick and big fellows 15″ in diameter 1½″ thick are turned out by Ajax Machines by the hundred thousands, day in and day out without breakdowns.

The tie rod re-enforced bed with rigid crankshaft housings; the sturdy twin gear driven crankshaft; and the drop lock that converts a maximum of flywheel energy into actual work are merely three of the exclusive Ajax Construction features you should acquaint yourself with before buying a forging machine.

Our Bulletin 63 will be sent upon request. Or better still, let one of our sales engineers call.

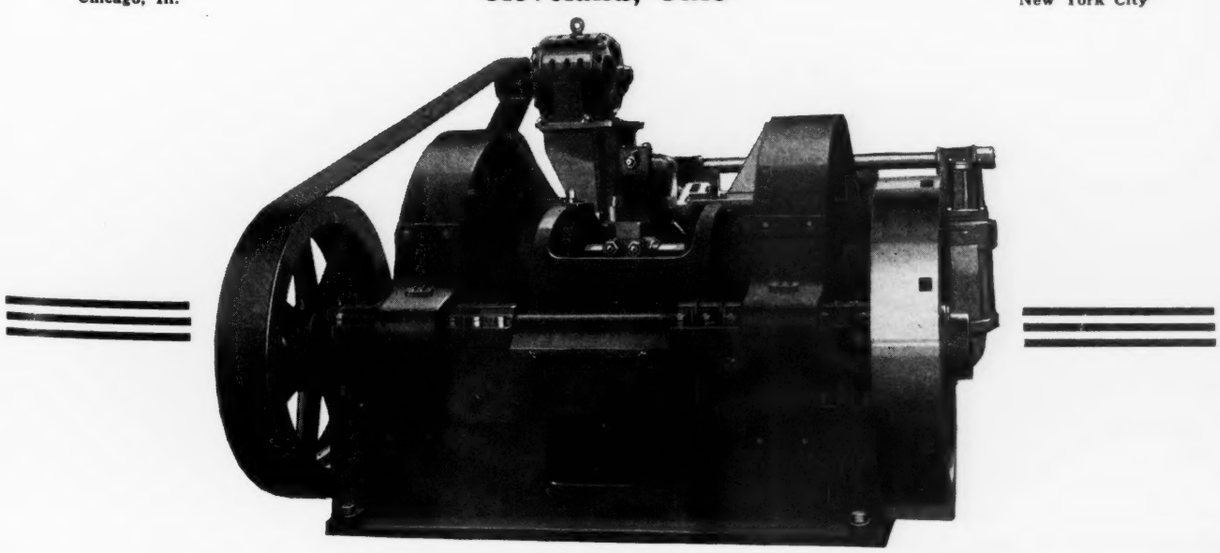
THE AJAX MANUFACTURING COMPANY

Euclid Branch P. O.

Cleveland, Ohio

621 Marquette Bldg.
140 So. Dearborn St.
Chicago, Ill.

1369 Hudson Terminal
50 Church St.
New York City



TRADE NOTES

GEARS AND FORGINGS, INC., Cleveland, Ohio, has established a New York office at 149 Broadway. Presley Hamilton is district sales representative, in charge of this office. Mr. Hamilton is well known in the New York territory, having been working in it for ten years.

Presley Hamilton, in Charge of New York Office of Gears and Forgings

ALFRED D. GUION & Co., Bridgeport, Conn., announces that the company has merged with it the Rowland Advertising Agency of the same city. With the previous acquisition of the Morgan Service, the company is in a position to render all-around advertising service in Bridgeport and vicinity.

BILLINGS & SPENCER Co., Hartford, Conn., manufacturer of drop-forged tools, forging machinery, and special forgings, has opened a New York office at 71 Murray St., Room 1205, with W. Roy Moore in charge as sales manager. Robert C. Smith will be associated with Mr. Moore, in charge of export sales.

KEARNEY & TRECKER CORPORATION, Milwaukee, Wis., is erecting a new three-story office building adjoining its present office structure, to provide increased facilities for offices that have up to the present time occupied shop space. This will release about 5000 square feet of shop area for manufacturing purposes.

PREST-O-LITE Co., INC., 30 E. 42nd St., New York City, has lately added two new plants to its chain of plants, making a total of thirty-three. One of these plants is at 631 S. 17th St., Harrisburg, Pa., with H. A. Smith in charge, and the other at 17th and W. Lawrence Sts., Allentown, Pa. J. W. Summers is superintendent of the latter plant.

EFFINGER & HOFFMAN, Canton, Ohio, are now located in their new building at 1406 Fifth St., Canton. The company has installed new equipment with a view to specializing on a line of special tools, jigs, and fixtures. P. H. Effinger, who was connected with the Hoover Co., North Canton, Ohio, for eight years, is general manager. William Hoffman is superintendent.

ROLLER-SMITH Co., 233 Broadway, New York City, maker of electrical instruments, radio apparatus, and circuit breakers, has appointed Elliott E. Van Cleef, 53 W. Jackson Boulevard, Chicago, Ill., district sales agent in the Chicago territory. Michael B. Mathley, who has been connected with the Chicago office for many years, will be associated with Mr. Van Cleef.

COVEL-HANCHETT Co., Big Rapids, Mich., builder of precision grinding machinery and saw and knife fitting machinery, has purchased the BADGER TOOL Co. of Beloit, Wis., maker of heavy-type disk grinding machines and double-end grinding machines. The Badger line of grinding equipment will be built in the future at the Covel-Hanchett Co.'s plant at Big Rapids, Mich.

MICHIGAN TOOL & DIE Co., Adrian, Mich., has been incorporated as the ORO MFG. Co., and has moved from Logan St. to West Church St., Adrian. The company will specialize in experimental work and the manufacture of castings, patterns, tools, and dies. Edward Leininger is president; M. B. Berkman, vice-president; Stephen J. Reck, secretary and treasurer; and F. H. Tagg, director.

LINDE AIR PRODUCTS Co., 30 E. 42nd St., New York City, announces that four new Linde plants have recently started the production of oxygen. These plants are located at 631 S. 17th St., Harrisburg, Pa.; 17th and W. Lawrence Sts., Allentown, Pa.; Foster and Thomas Sts., Shreveport, La.; First Ave. and B St., South Charleston, W. Va. J. J. Naber is in charge of the Harrisburg plant, W. Barber of the Allentown plant, F. T. Rueger of the Shreveport plant, and Ed Pohlman of the South Charleston plant. This makes a total of fifty-two Linde oxygen-producing plants.

DAVIS BORING TOOL Co., DIVISION OF LARKIN PACKER Co., has moved into its new factory at 6200 Maple Ave., St. Louis, Mo. The building has been added to the present group now used by the Larkin Packer Co. The new factory is of the latest modern daylight type, and machinery will be arranged for progressive production. An entirely new heat-treating department is being installed, equipped with automatic controlled electric furnaces. The combined organizations will consist of three plants, one 250 by 63 feet; one, 170 by 55 feet; and the third, 150 by 70 feet, with additional ground for expansion.

COMING EVENTS

SEPTEMBER 4-7—Canadian Steel and Power Show, University of Toronto Arena, Toronto, Ontario, Canada. Campbell Bradshaw, secretary, 24 Front St. West, Toronto.

SEPTEMBER 5-22—Fourth Machine Tool and Engineering Exhibition to be held at Olympia, London, England.

SEPTEMBER 12-14—Annual convention of the American Railway Tool Foremen's Association in Chicago, Ill.; headquarters, Hotel Sherman. Secretary and treasurer, F. A. Armstrong, 564 W. Monroe St., Chicago, Ill.

SEPTEMBER 17-20—Second national meeting of the Fuels Division of the American Society of Mechanical Engineers to be held in Cleveland, Ohio. Chairman of Fuels Division, Victor J. Azbe, American Society of Mechanical Engineers, 29 W. 39th St., New York City.

SEPTEMBER 20—Regular monthly meeting of the Electric Hoist Manufacturers' Association at the Hotel McAlpin, New York City. Secretary, E. Donald Tolles, 165 Broadway, New York City.

SEPTEMBER 24-27—National Machine Shop Practice meeting of the American Society of Mechanical Engineers in conjunction with the Cincinnati Section of the society, L. C. Morrow, Tenth Ave. and 36th St., New York City, chairman of the Machine Shop Practice Division of the A.S.M.E.

SEPTEMBER 24-27—Joint meeting of the Machine Tool Congress in Cincinnati, Ohio, and the Machine Shop Practice Division of the American Society of Mechanical Engineers. Ernest F. DuBrul, secretary, Provident Bank Bldg., Cincinnati, Ohio.

OCTOBER 8-12—Annual convention of the American Society for Steel Treating at Benjamin Franklin Hotel, Philadelphia, Pa. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

OCTOBER 8-12—Annual meeting of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers at Benjamin Franklin Hotel, Philadelphia, Pa. W. M. Corse, secretary, 810-18th St., N.W., Washington, D. C.

OCTOBER 8-12—Fall meeting of the American Welding Society at Bellevue-Stratford Hotel, Philadelphia, Pa. M. M. Kelley, secretary, 33 W. 39th St., New York City.

OCTOBER 8-12—Tenth National Metal Exposition held under the auspices of the American Society for Steel Treating at the Commercial Museum, Philadelphia, Pa. For further information, address W. H. Eisenman, National Secretary, 7016 Euclid Ave., Cleveland, Ohio.

OCTOBER 11-13—Semi-annual meeting of the American Gear Manufacturers' Association at the Hotel Statler, Buffalo, N. Y. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

OCTOBER 17-19—Fifteenth national convention of the Society of Industrial Engineers at Rochester, N. Y., in joint meeting with the Industrial Management Council of the Rochester Chamber of Commerce; headquarters, Chamber of Commerce and Hotel Seneca. Further information may be obtained from the office of the society, 205 W. Wacker Drive, Chicago, Ill.

OCTOBER 17-19—Electrical and Industrial Exposition to be held in Grand Central Palace, New York City. For further information, address the Electrical and Industrial Exposition, 130 E. 15th St., New York City.

NOVEMBER 13-15—Convention of the American Management Association at Palmer House, Chicago, Ill. Secretary's address, 20 Vesey St., New York City.

NOVEMBER 14-15—Second national meeting of the Iron and Steel Division of the American Society of Mechanical Engineers in conjunction with the Chicago Section of the society. Thomas Wilson, 7 S. Dearborn St., Chicago, Ill., chairman of the Chicago Local Section.

DECEMBER 3-7—Annual meeting of the American Society of Mechanical Engineers to be held in the Engineering Societies Building, New York City. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

SEPTEMBER 30-OCTOBER 4, 1929—Machine Tool Exposition at Cleveland, Ohio, under the auspices of the National Machine Tool Builders' Association. Ernest F. DuBrul, general manager, 630 Vine St., Cincinnati, Ohio.

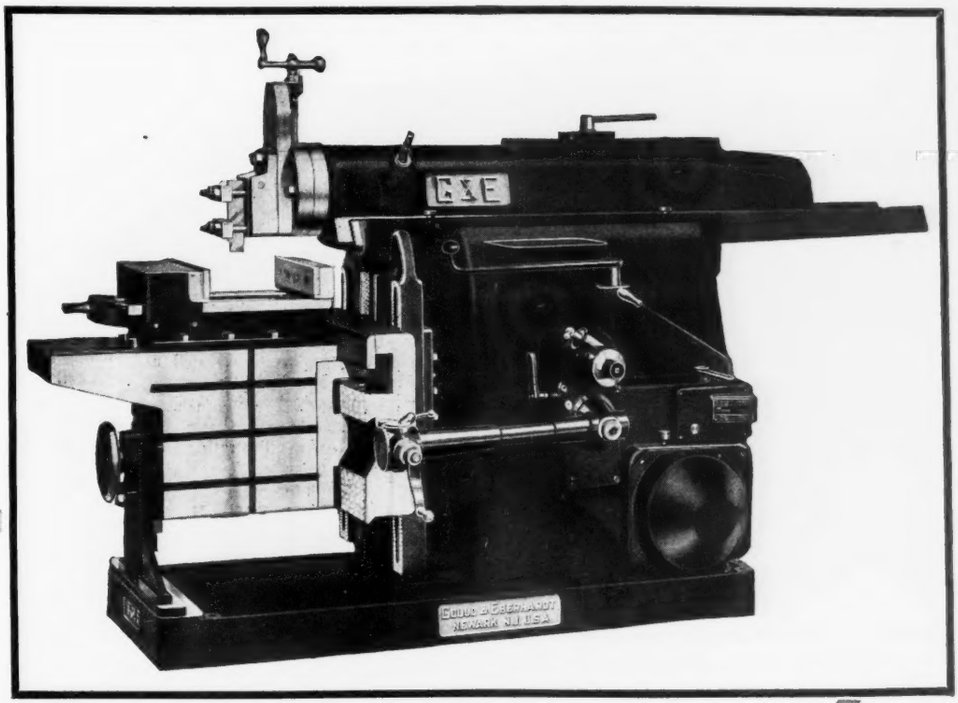
SOCIETIES, SCHOOLS AND COLLEGES

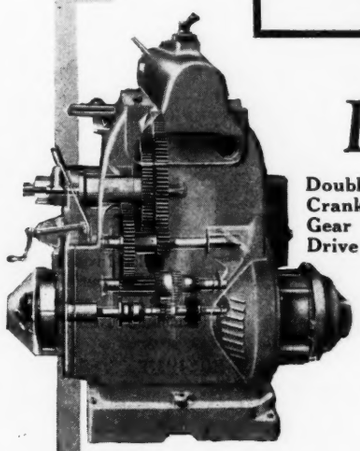
COLUMBIA UNIVERSITY, Morningside Heights, New York City. Bulletin announcing afternoon and evening courses in business for 1928-1929, beginning September 27.

OHIO MECHANICS INSTITUTE, Central Parkway and Walnut St., Cincinnati, Ohio. Circular containing an announcement of the evening classes for 1928-1929, beginning October 1.

POLYTECHNIC INSTITUTE, Brooklyn, N. Y. Seventy-third annual catalogue of the College of Engineering, 1928-1929; and bulletin of the evening session, College of Engineering, 1928-1929.

G&E Manufacturing Shaper





Double Crank Gear Drive

Profit Earning Features not to be overlooked

The G & E Manufacturing Shaper combines many original features, perfectly synchronized and forming a unit of unmatched production ability. Economy, Accuracy, Speed, Versatility are attributes of this machine that make every job profitable.

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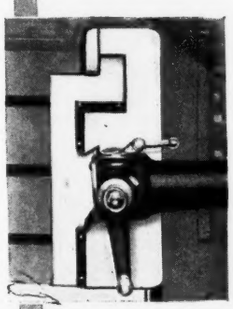
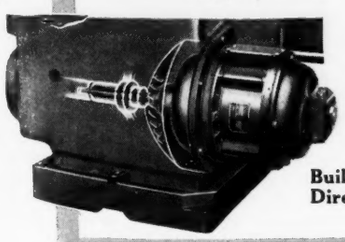


New Zee-Type Work Slide



Built-in Motor—Direct Coupled

GOULD & EBERHARDT

NEWARK (Irvington), N. J., U. S. A.

NEW BOOKS AND PAMPHLETS

GETTING FACTS ABOUT ACCIDENTS. Industrial Safety Pamphlet No. 2. Published by the Metropolitan Life Insurance Co., New York City.

NEMA HANDBOOK OF APPARATUS STANDARDS. 348 pages, 6 by 9 inches. Published by the National Electrical Manufacturers Association, 420 Lexington Ave., New York City. Price, $3.

MACHINE SHOP UNIT (Part I). Process sheets prepared for vocational schools by William C. Bahr, F. A. Boltz, and D. E. Weber, machine shop instructors; edited by H. C. Thayer, Wisconsin state supervisor of teacher training. 12 sheets, 8½ by 11 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, 35 cents.

THE FOREMAN AND LABOR TURNOVER. 15 pages, 5½ by 7¾ inches. Distributed by the Policyholders' Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York City, as the third of a series on labor turnover.

This leaflet is written primarily for foremen, department heads, and personnel managers. Its purpose is to show how foremen can aid in the control of labor turnover and how their interest in such a program can be maintained. The information furnished in this pamphlet is based upon data supplied by forty-two manufacturing companies of varying sizes, but large enough to have centralized employment.

INFLUENCING MEN IN BUSINESS. By Walter Dill Scott. 172 pages, 6 by 8½ inches. Published by the Ronald Press Co., 15 E. 26th St., New York City. Price, $3.

The author of this book—the president of the Northwestern University—is a man of broad personal knowledge of the methods of dealing with men. The present edition has been revised and enlarged by Delton T. Howard, associate professor of psychology and director of personnel at the Northwestern University. The aim of the book, which was first published seventeen years ago, is to explain the principles of dealing with people, especially as these principles apply to selling and advertising. The method of presentation is such that anyone interested will have no difficulty in understanding and applying the suggestions. The chapter headings indicate in a general way the way in which the subject is treated, the book being divided into ten chapters as follows: Introductory; An Analysis of Deliberation; An Analysis of Suggestion; Deliberation and Suggestion Contrasted; Types of Decision; The Several Types of Suggestion; When to Use Arguments in Influencing Men; When to Use Suggestion in Influencing Men; Making Arguments Effective; and Making Suggestions Effective. Anyone engaged in business, and especially those whose success depends mainly on their success in dealing with others, will find much of value in this book.

NEW CATALOGUES AND CIRCULARS

SUPERHEATERS. Superheater Co., 17 E. 42nd St., New York City. Catalogue entitled "The Elesco Superheater for Power Plants."

ACETYLENE GENERATORS. Oxweld Acetylene Co., 30 E. 42nd St., New York City. Booklet illustrating and describing the "Carbic" low-pressure acetylene generator.

LIGHTING EQUIPMENT. Cooper Hewitt Electric Co., 95 River St., Hoboken, N. J. Catalogue illustrating installations of Cooper Hewitt "Work-Light" in various industries.

CHUCKS AND COLLETS. Titan Tool Co., Erie, Pa. Catalogue 3, covering production tools for drilling and tapping, including quick-change chucks and collets, adapters, and stud setters.

ELECTRIC FURNACES. Harold E. Trent Co., 439 N. 12th St., Philadelphia, Pa. Leaflet TA-20, containing data on Trent electric furnaces of the pot, trough, pit, and direct heat types.

LIGHTING EQUIPMENT. Oxweld Acetylene Co., 30 E. 42nd St., New York City. Booklet entitled "The Carbic Light," illustrating and describing portable flood-lights for industrial purposes.

AUTOMATIC THREAD-CUTTING DIES. Jones & Lamson Machine Co., Springfield, Vt. Circular announcing the new J & L 8H and 10H Hartness automatic dies, designed for threading large parts.

SHOP FANS. Peerless Electric Co., Warren, Ohio. Circular illustrating and describing the "Peerless man cooler," a portable fan for use in the shop wherever men are working on hot or dusty jobs.

CHAIN DRIVES. Diamond Chain & Mfg. Co., Indianapolis, Ind. Pamphlet entitled "The Modern Timing Drive," describing and illustrating the Diamond timing drive chain for automobiles.

CRANES. Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Crawler Crane Book No. 995, covering the complete Link-Belt line of gasoline, Diesel and electric crawler cranes, as well as standard locomotive cranes.

ELECTRIC EQUIPMENT. Westinghouse Electric & Mfg. Co., Sharon Works, Sharon, Pa. Leaflets 20361 and 20362, illustrating, respectively, the type TR and the type TF tap changer for power transformers.

ELECTRIC OVEN HEATERS. H. O. Swoboda, Inc., 3400 Forbes St., Oakland Station, Pittsburgh, Pa. Bulletin 130, describing the Falcon open radiant oven heaters having many industrial uses, as, for example, for baking and drying ovens.

STEEL STRINGERS AND BOX RAILS. Midwest Steel & Supply Co., Inc., Bradford, Pa. Circular illustrating and describing steel stringers for supporting overhead equipment. Circular of box rails for facilitating overhead lay-out in shops.

WELDING EQUIPMENT. Lincoln Electric Co., Cleveland, Ohio. Bulletin entitled "Automatic Arc-welding by the Electronic Tornado Process," illustrating and describing work done by this process, the equipment required, and the results obtained.

VARIABLE-SPEED TRANSMISSION. Reeves Pulley Co. of New York, Inc., 76 Dey St., New York City. Bulletin descriptive of the Reeves variable-speed transmission, dealing particularly with various new designs of units that have recently been developed.

MARKING DEVICES. Noble & Westbrook Mfg. Co., Hartford, Conn. Pamphlet entitled "Trademarking Your Goods," emphasizing the need of trademarks, and giving information on invalid trademarks, titles to trademarks, recording trademarks, and methods of marking metal.

FACTORY TRACTORS. Caterpillar Tractor Co., San Leandro, Calif. Illustrated booklet entitled "Caterpillar Power for Factories," showing applications of Caterpillar tractors to numerous industrial applications. Another booklet deals with Caterpillar power for railroads, docks, and warehouses.

NICKEL STEEL. International Nickel Co., Inc., 67 Wall St., New York City. Pamphlet entitled "User Experience—The Key to Future Nickel Steel Applications," outlining the promotion work of the company in furthering the uses and applications of nickel alloy steel, based on the experience of users.

INDICATING AND RECORDING INSTRUMENTS. Brown Instrument Co., Philadelphia, Pa. Catalogue 93, containing complete information on Brown resistance thermometers of the indicating, recording, and controlling types, for measuring temperatures from — 300 degrees to + 1000 degrees F.

MOTORS. American Electric Motor Co., Cedarburg, Wis. Bulletins 101 and 102, on American electric motors. Bulletin 101 illustrates the use of these motors in various industries under a variety of operating conditions. Bulletin 102 contains a general description of the various types, the advantages of each, and the method of manufacture.

DRILLING AND TAPPING CHUCKS. Apex Machine Co., 301 Davis Ave., Dayton, Ohio. Catalogue 5 (20 pages, pocket size), describing the complete line of Apex drilling and tapping chucks, both positive and friction drive for single-and multiple-spindle operations. The catalogue also contains data on universal joints and stationary and revolving die-heads.

CRANES. Cleveland Crane & Engineering Co., Wickliffe, Ohio. Catalogue C-100, entitled "Cleveland Arc-welded Roller-bearing Crane," describing the features of construction of this type of overhead traveling crane, in which arc-welding is used in place of riveting and castings, and in which roller bearings are used throughout. The catalogue is illustrated with detailed photographs and drawings.

MILLING MACHINES. Ingersoll Milling Machine Co., Rockford, Ill. Bulletin illustrating adjustable-rail milling machines and their application on general work, as, for example, in shops building steam and oil engines, excavating and hoisting machinery, machine tools, printing presses, textile machinery, and many other lines where the work is varied and the castings are handled singly or in small lots.

WELDING EQUIPMENT. Federal Machine & Welder Co., Dana Ave., Warren, Ohio. Bulletin 260, illustrating and describing heavy-duty spot welders. The catalogue also includes a brief treatise on the theory of spot welding, indicating when this process is applicable and showing different types of welding points used in spot welding. The method of projection welding is also illustrated and described.

DRILL JIG BUSHINGS. Ex-Cell-O Tool & Mfg. Co., 1200 Oakman Boulevard, Detroit, Mich. Catalogue B-28, containing a complete list of the various sizes of drill jig bushings made by this concern. The list gives the symbol number, drill size, code word, and counterbore diameter and length. Thus by referring to the hole size desired, the user will find all bushings of that size in one place with all symbol dimensions, code words, etc.

CARBURIZING EQUIPMENT. American Gas Furnace Co., Elizabeth, N. J. Bulletin 12-A, covering carburizing machines and furnaces. The bulletin contains illustrated descriptions of this equipment and also brief treatises under the headings "Principles Involved in Gas Carburizing"; "Purpose of Carburizing"; and "Construction of Carburizing Machines." In addition, each size of machine is illustrated and described and specifications given.

ELECTRICAL EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin 423A, on arc welding in General Electric factories; Bulletin 992, descriptive of automatic tank welder; Bulletin 874B, on type WD-200A arc welder; Bulletin 995, discussing arc welding in industry; Bulletin 1009, describing gas-engine-driven arc welder; Bulletin 1022, on automatic arc welder for steel railroad ties; Bulletin 1031, dealing with resistor arc welders; Bulletin 37C, on electric furnaces; Bulletin 38A, descriptive of crane and hoist motors; Bulletin 405A, dealing with elevator service induction motors; Bulletin 998, on portable hoist motors; Bulletin 451A, descriptive of MT control for direct-current mill and crane motors; Bulletin 861, dealing with class BM motors and control.

GRINDING WHEELS. American Emery Wheel Works, Providence, R. I. Catalogue 8, on American grinding wheels and abrasive grains. Particular attention is called in this catalogue to the abrasive grain known as "Aluminox," which is an oxide of aluminum abrasive best suited for work on materials of high tensile strength. The catalogue contains brief information on processes of manufacture, testing, causes of grinding wheel accidents, operating speeds, methods of mounting grinding wheels, and selection and use of wheels. The second section of the book contains complete tabulated data giving list prices for grinding wheels of various diameters and thicknesses, and rules for calculating list prices. A section is also included containing data on special shaped wheels applicable to machines of special make.